PB90-910201

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 23, NUMBER 1
JANUARY 1990

W90-00001 — W90-00961
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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W90-00001 — W90-00961

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1990.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

REQUIREMENTS FOR AND USE OF A FLOOD AND AGRO-ECONOMIC DATA BASE.
Willing and Partners, Canberra (Australia).
For primary bibliographic entry see Field 7A.
W90-00111

APPLICATION OF THE PRECIPITATION-RUNOFF MODEL IN THE WARRIOR COAL FIELD, ALABAMA.
Geological Survey, Tuscaloosa, AL.
R. E. Kidd, and C. R. Bossong.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2306, 1987. 42p, 17 fig, 16 tab, 41 ref.

Descriptors: *Model studies, *Alabama, *Hydrologic models, *Rainfall-runoff relationships, Runoff, Warrior Coal Field, Hydrographs, Geohydrology, Watersheds, Flow profiles, Turkey Creek, Bear Creek, Basins.

A deterministic precipitation-runoff model, the Precipitation-Runoff Modeling System, was applied in two small basins located in the Warrior coal field, Alabama. Each basin has distinct geologic, hydrologic, and land use characteristics. Bear Creek basin (15.03 sq mi) is undisturbed, is underlain almost entirely by consolidated coal bearing rocks of Pennsylvanian age (Pottsville Formation), and is drained by an intermittent stream. Turkey Creek basin (6.08 sq mi) contains a surface coal mine and is underlain by both the Pottsville Formation and unconsolidated clay, sand, and gravel deposits of Cretaceous age (Coker Formation). Aquifers in the Coker Formation sustain flow through extended rainless periods. Preliminary daily and storm calibrations were developed for each basin. Initial parameter and variable values were determined. Parameters with meaningful sensitivity were identified and adjusted to match hydrograph shapes and to compute realistic water year budgets. When the developed calibrations were applied to data exclusive of the calibration period as a verification exercise, results were comparable to those for the calibration period. The model calibrations included preliminary parameter values for the various categories of geology and land use in each basin. The parameter values for areas underlain by the Pottsville Formation in the Bear Creek basin were transferred directly to similar areas in the Turkey Creek basin, and these parameter values were held constant throughout the model calibration. Parameter values for all geologic and land-use categories addressed in the two calibrations can probably be used in ungaged basins where similar conditions exist. The parameter transfer worked well, as a good calibration was obtained for Turkey Creek basin. (Author's abstract)
W90-00214

OVERLAND FLOW MODELING: CAN RAINFALL EXCESS BE TREATED AS INDEPENDENT OF FLOW DEPTH.
Technische Univ., Vienna (Austria). Inst. fuer Hydraulik Gewasserkunde und Wasserwirtschaft.
For primary bibliographic entry see Field 2E.
W90-00350

INFLUENCE OF THE 1982-83 DROUGHT ON RIVER FLOWS IN HAWKE'S BAY.
Hauraki Catchment Board, Te Aroha (New Zealand).
For primary bibliographic entry see Field 2E.
W90-00932

MEASURED AND SIMULATED WATER RELATIONS IN A DOUGLAS-FIR FOREST DURING THE DEVELOPMENT OF DROUGHT IN THE APENNINES, CENTRAL ITALY.
Centro di Studio per la Genesi Classificazione e Cartografia del Suolo, Florence (Italy).
P. J. Kowalik, M. Borghetti, E. Busoni, G. Sanesi, and G. G. Vendramin.
Forest Ecology and Management FECMDW, Vol. 25, No. 3-4, p 181-194, November 1988. 7 fig, 1 tab, 25 ref.

Descriptors: *Soil-water-plant relationships, *Forest hydrology, *Drought, Italy, Fir trees, Alpine regions.

A model of soil water dynamics (SWATRE) and of the soil-plant-atmosphere continuum (SPAC), including the plant water-retention component, were applied independently to describe the seasonal and diurnal water balance of a forest in Italy. The stand under consideration was a 26-year-old Douglas-fir plantation with a density of 2044 trees ha-1 and average height of 14.2 m, located in the Apennines in Central Italy, 900 m a.s.l, in a mediterranean climate. Soil water potential was measured with tensiometers and psychrometers 2 or 3 times/week during the summer of 1985. The xylem water potential and leaf stomatal conductances were measured on 4 days in the period June-September 1985, at about 2-3-h intervals from sunrise to sunset. Global and net solar radiation, air temperature and air relative humidity above the canopy were measured. Soil water potentials simulated by the SWATRE model agreed well with the field measurements. The diurnal pattern of bulk stomatal resistance and xylem water potential simulated by the SPAC model also agreed with measurements. The results show that Douglas-fir is surprisingly well adapted to the drought conditions that occurred in Tuscany during the dry year 1985, and even with dry soil, shallow rooting depth and high evaporative demand, trees did not show evident water stress. (Author's abstract)
W90-00958

2B. Precipitation

RAINFALL ABSTRACTION AND INFILTRATION IN NONPOINT SOURCE POLLUTION.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00004

STATISTICAL RAIN ATTENUATION PREDICTION MODEL WITH APPLICATION TO THE ADVANCED COMMUNICATION TECHNOLOGY SATELLITE PROJECT. I--THEORETICAL DEVELOPMENT AND APPLICATION TO YEARLY PREDICTIONS FOR SELECTED CITIES IN THE UNITED STATES.
Analex Corp., Cleveland, OH.
R. M. Manning.
Available from the National Technical Information Service, Springfield, VA 22161, as N88-29077. Price codes: A10 in paper copy, A01 in microfiche. NASA Contractor Report No. 179498, September 1986. 203p, 13 fig, 11 tab, 7 append. NASA Contract NAS3-24564.

Descriptors: *Rain, *Model studies, *Satellite technology, Data acquisition, Statistical models, Hydrologic data, Mathematical studies, Prediction.

A rain attenuation prediction model is described for use in calculating satellite communication link availability for any specific location in the world that is characterized by a long-term meteorological record of rainfall. Such a formalism is necessary for the accurate assessment of such availability predictions in the case of the small user-terminal concept of the Advanced Communication Technology Satellite (ACTS) Project. The model employs the theory of extreme value statistics to generate the necessary statistical rain-rate parameters from rain data in the form compiled by the National Weather Service. These location dependent rain statistics are then applied to a rain attenuation on any satellite link at that location. The predictions of this model are compared to those of the Crane Two-Component Rain Model and some empirical data and found to be very good. The model is then used to calculate rain attenuation statistics at 59 locations in the United States (including Alaska and Hawaii) for the 20 GHz downlinks and 30 GHz uplinks of the proposed ACTS system. The flexibility of this modeling formalism is such that it allows a complete and unified treatment of the temporal aspects of rain attenuation that leads to the design of an optimum stochastic power control algorithm, the purpose of which is to efficiently counter such rain fades on a satellite link. (Author's abstract)
W90-00094

NEED FOR CLIMATIC AND HYDROLOGIC DATA IN AGRICULTURE IN SOUTHEAST ASIA.
For primary bibliographic entry see Field 7A.
W90-00100

APPLICATION OF CLIMATIC AND HYDROLOGICAL DATA IN STABILIZING PRODUCTION SYSTEMS IN THE HUMID AND WET-DRY TROPICS OF ASIA.
Agrarian Research and Training Inst., Colombo (Sri Lanka).
For primary bibliographic entry see Field 3F.
W90-00101

PROBLEMS RELATED TO THE EFFECTS OF ENVIRONMENTAL CONDITIONS ON THE IMPROVEMENT OF AGRICULTURE IN SOUTH-EAST ASIA.
Snowy Mountains Engineering Corp., Cooma (Australia).
For primary bibliographic entry see Field 3F.
W90-00102

APPLICATION OF AGROMETEOROLOGICAL INFORMATION IN RELATION TO RICE-BASED CROPPING PATTERNS IN SOUTH-EAST ASIA.
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 3F.
W90-00104

ESTIMATING CLIMATIC DATA.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 7C.
W90-00105

USE OF CLIMATIC DATA TO CLASSIFY AND COMPARE ENVIRONMENTS.
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
J. S. Russell.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 73-84, 3 fig, 3 tab, 27 ref.

Descriptors: *Climatic data, *Data collections, *Water resources data, *Climatology, *Data interpretation, *Meteorology, Classification, Australia, Meteorological data collection, Mathematical studies, Temperature, Solar radiation, Fourier analysis.

The use of climatic data is discussed in relation to the classification of climate, the definition of homoclimates and the comparison of specific meteorological stations. Some of the difficulties of using current classifications are shown in comparing seven climatic stations in subtropical and tropical northern Australia. Numeral taxonomic approaches to classification are considered and these have some advantages in the agglomerative, as opposed to divisive classifications, are possible. The incorporation of variability information and the use of fuzzy sets need to be examined further. There are limitations in the data sets available in many parts of the world but local classifications using such approaches are possible. The definition of homoclimates using similarity or dissimilarity measures is

useful in comparing stations. The use of Fourier series to describe periodic data, the combination of these series in vector functions, and project onto defined planes is discussed. It is possible to use this approach to compare relationships between more than two climatic variables at stations. For example, projects were made of the relationships between: (1) daylength and radiation, (2) radiation and mean maximum temperature, and (3) radiation and pan evaporation at four stations in northern Australia. These projections are useful in describing not only the relationships between the variables at one station but also making comparisons with other stations. (See also W90-00100) (Lantz-PTT)
W90-00106

USE OF RESIDENCE TIME DISTRIBUTION IN AGROCLIMATIC CLASSIFICATION.
New South Wales Univ., Kensington (Australia). Dept. of Water Engineering.
T. G. Chapman.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 85-94, 4 fig, 2 tab, 9 ref.

Descriptors: *Data collections, *Water resources data, *Agricultural hydrology, *Water storage, *Climatology, Mathematical analysis, Mathematical models, Hydrologic models, Soil water, Hydrologic data, Classification.

Turnover time is the characteristic replenishment time of hydrological storage. Age is a measure of the elapsed time since a molecule of water entered the storage, and residence time is the value of the age when water leaves the storage; both can be expressed in terms of a time-varying frequency distribution. All three quantities are defined, and relations are developed between them and the storage inputs and outputs. For a given sequence of storage input and output data, the age and residence time distributions can be estimated on the basis of simple models which require no knowledge of the geometry or hydraulics of the storage. Another method of determining these distributions is through use of data on input and output of conservative, radioactive or reactive tracers. In the context of agricultural climatology. the storage of greatest relevance is the soil water store within the plant root zone. It is suggested that the mean turnover time could be a first measure for classifying such stores, while the residence time distribution would give greater definition and would distinguish between stores which have the same turnover time but quite different hydrologic behavior. These points are illustrated with synthetic soil water data using a simple WATBAL model, and input-output data from lysimeters. (See also W90-00100) (Author's abstract)
W90-00107

NEW OBJECTIVE METHOD FOR SPATIAL INTERPOLATION OF METEOROLOGICAL VARIABLES FROM IRREGULAR NETWORKS APPLIED TO THE ESTIMATION OF MONTHLY MEAN SOLAR RADIATION, TEMPERATURE, PRECIPITATION AND WINDRUN.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 7C.
W90-00108

DROUGHT ASSESSMENT THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA.
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
For primary bibliographic entry see Field 2E.
W90-00109

MODEL-BASED APPROACH TO THE USE OF CLIMATIC DATA FOR ASSESSING PROBABILITIES OF RAINDAY AND DRYDAY SEQUENCES.
R. Jardins.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 147-156, 31 ref.

Descriptors: *Climatic data, *Data collections, *Water resources data, *Meteorologic data collection, *Model studies, *Climatology, *Rainfall, *Water shortage, *Data interpretation, Precipitation, Agricultural hydrology, Hydrologic data, Queensland, Australia.

A number of points in favor of the use of a model-based approach to the analysis of daily climatic data are made. In particular, in contrast with non-model based approaches which usually require a separate examination of the data to meet each specific need, the flexibility of a model in producing results to meet a range of requirements is stressed. The success of Markov chain models for modeling the frequency of occurrence of rain day/dry day amounts is discussed. Coupled with computer facilities, a two-part model may be formulated to derive a range of summary statistics and to enable the derivation of expressions of the probability of precipitation occurrence and of precipitation amounts relevant to both agriculture and hydrology. Although probability statements are more reliable when related either to a large number of occurrences or to a long period of time, their use is considered important in terms of agricultural planning since they offer a consistent and 'best available' approach. In addition, when historical records of daily rainfall are short and/or discontinuous, representative synthetic data may be generated using parameters ascribed to the model in a similar climatic regime. Some illustrative examples of the use of a model based approach in relation to agriculture in south-east Queensland are presented. Using several rainfall threshold values, several short time periods and a number of approaches, a two-part model is used to assess a range of probabilities relevant to phases of the cereal cropping period. Mention is also made of the possible extensions to the model. (See also W90-00100) (Author's abstract)
W90-00112

ASSESSMENT OF RAINFALL EROSION HAZARD.
Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 2J.
W90-00113

RISK ANALYSIS OF WHEAT YIELDS IN RELATION TO CULTIVAR MATURITY AND CLIMATIC VARIABILITY IN SEMI-ARID AREAS, USING A CROP GROWTH MODEL.
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 3F.
W90-00114

SIMPLE MODELS FOR USE BY ADVISORY OFFICERS TO DEFINE CROP STRATEGIES AND TO PREDICT FARM YIELDS.
South Australia Dept. of Agriculture, Adelaide. Div. of Land Use and Protection.
For primary bibliographic entry see Field 3F.
W90-00115

SIMULATION MODEL FOR MULTIPLE CROPS IN A RAINFED RICE-BASED CROPPING SYSTEM.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
J. F. Angus.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 195-208, 5 fig, 2 tab, 21 ref.

Descriptors: *Data collections, *Water resources data, *Simulation analysis, *Model studies, *Agricultural hydrology, *Rice, *Rainfall, Climatic data, Hydrologic budget, Drought, Meteorology, Temperature, Evapotranspiration.

Rainfed wetland rice is the major type of rice culture in southeast Asia and most is grown in cropping systems, i.e., in sequence with other rice or upland crops. Climatic analyses based on the water balance of upland crops do not apply to rainfed wetland cropping systems. Modifications are needed to account for several major differences including the drought sensitivity of rice, its shallow, anaerobic root zone, the large lateral contribution of water from upslope fields, and the complexity of multiple cropping when some but not all crops are adapted to saturated soils. A simulation model has been devised for the water balance of wetland fields and the growth and development of crops grown in sequence. However, a lack of information on lowland water balance, nitrogen dynamics, and the timing of a cropping pattern, provide limitations for model use. To operate this model requires estimates of daily rainfall for a long series of years for a network of representative and well distributed sites. Records of evapotranspiration rate are also needed, either as records of pan evaporation or estimates of evapotranspiration such as obtained by the Penman method. Of the other requirements for the mode, temperature is relatively unimportant for the lowland humid tropics because of its lack of variation and the lack of growth response within the narrow range of temperatures experienced. At higher elevations, temperatures may become limiting for growth. The close association between temperatures and elevation can be used to supplement measured temperatures. Solar radiation is extremely important as the source of energy for photosynthesis and evapotranspiration. (See also W90-00100) (Lantz-PTT)
W90-00116

EVALUATION THE EFFECT OF CLIMATIC VARIABILITY ON MANAGEMENT OF DRY-LAND AGRICULTURAL SYSTEMS IN NORTH-EASTERN AUSTRALIA.
Queensland Dept. of Primary Industries, Brisbane (Australia).
For primary bibliographic entry see Field 3F.
W90-00117

USE OF CLIMATIC DATA WITH A CROP WATER BALANCE MODEL AND CROP AND PEST RESPONSE MODELS IN NORTHERN NEW SOUTH WALES.
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
For primary bibliographic entry see Field 3F.
W90-00118

BUREAU'S DATA BANK--HOW IT WORKS.
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 7C.
W90-00119

ASPECTS OF HYDROMETEOROLOGICAL DATA, MEASUREMENT, ANALYSIS AND APPLICATION.
University of New England, Armidale (Australia). Faculty of Resource Management.
I. J. Jackson.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 269-276, 15 ref.

Descriptors: *Hydrologic data collections, *Meteorological data collection, *Data collections, *Water resources data, *Hydrometeorology, Data acquisition, Data interpretation, Rainfall, Forecasting, Training, Data storage and retrieval.

A range of problems exists in measurement, analysis and application of data, including dangers of generalization, poor data quality, marked spatial variations in tropical rainfall and the use of inappropriate models and approaches. Studies of a range of rainfall characteristics, particularly those for shorter periods, are important. In seasonal rainfall areas, improved forecasting of the start of rainy seasons would be valuable but faces many problems. Improvement of data collection facilities and analysis is particularly important in some of the drier areas of Southeast Asia. Application of extra-tropical models and concepts to the Southeast Asia situation may be dangerous. Factors other than scientific ones may be paramount in decision making and therefore, data and analysis must facilitate the implementation of decisions not regarded as most appropriate in scientific terms. Overseas training presents a range of potential problems and although necessary in some cases, training in the 'home' country is likely, on balance, to be more appropriate where possible. (See also W90-00100) (Author's abstract)
W90-00122

SYNOPTIC AND MESO-ALPHA SCALE METEOROLOGY OF WYOMING FLASH FLOODS.
National Weather Service Forecast Office, Cheyenne, WY.
J. A. Rogash.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117709. Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Memorandum NWS CR-93, October 1988. 23p, 17 fig, 13 ref. NOAA Project WR3000 8M1J10.

Descriptors: *Rainfall-runoff relationships, *Flash floods, *Meteorology, *Wyoming, Terrain analysis, Temperature, Rainfall intensity, Climatology, Seasonal variation, Air circulation, Convection.

The combination of high terrain features, warm temperatures and moisture intrusions makes Wyoming susceptible to dangerous thunderstorms which produce very heavy rains with flash floods. Since such storms are difficult to forecast, a study was performed investigating synoptic and meso-alpha scale meteorological factors associated with their occurrence. Data and meteorological patterns were examined for an eight-year period for all days in which Wyoming experienced at least one flash flood. Climatologically, it was found that the vast majority of Wyoming's flash flood coincided with the southwest U.S. monsoon season, taking place in July and August during the afternoon and evening hours. The circulation pattern over the western and central U.S. were similar several hours prior to heavy rainfalls. At the surface, thermal troughing west of the Continental Divide combined with high pressure over the Northern or Central Plains to generate a low level easterly wind component with inflow of abundant moisture into the state. In the middle troposphere, weak to moderate winds with a westerly or southerly component were established with advection of Pacific or Gulf of California moisture aloft. In such an environment a moist unstable air mass could form over Wyoming with a marked vertical directional wind shear favorable for deep convection. A primary trigger for Wyoming heavy thunderstorms was terrain-forced upward motion due to the easterly component of the surface winds. In addition, in most, though not all cases, dynamic lifting was present due to the approach of a short wave trough embedded in the middle tropospheric flow. (Author's abstract)
W90-00237

EXPERIENCES WITH TWO HOT WIRE INSTRUMENTS FOR MEASURING THE LIQUID WATER CONTENT IN CLOUDS.
Oak Ridge National Lab., TN. Information Research and Analysis Div.
For primary bibliographic entry see Field 7B.
W90-00244

EFFECTS OF ACID DEPOSITION ON THE CATCHMENT AREA OF LAKE MARSJOEN-BASIC STUDY (HAPPAMAN LASKEUMAN VAIKUTUKSISTA MARSJON-JARVEN VALUMA-ALUFELLA PRUSELVITYS).
Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.
For primary bibliographic entry see Field 5C.
W90-00276

RELATION BETWEEN ANTHROPOGENIC SO2 EMISSIONS AND CONCENTRATION OF SULFATE IN AIR AND PRECIPITATION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5B.
W90-00343

HYDROXYALKYLSULFONATE FORMATION: ITS ROLE AS A S(IV) RESERVOIR IN ATMOSPHERIC WATER DROPLETS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W90-00344

CLOUDWATER CHEMISTRY IN SEQUOIA NATIONAL PARK.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. Collett, B. Daube, J. W. Munger, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 999-1007, May 1989. 6 fig, 3 tab, 23 ref. Calif. Air Resources Board Contract A4-075-32.

Descriptors: *Interception, *Atmospheric water, *Clouds, *Acid rain, *Air-earth interfaces, Hydrogen ion concentration, Sulfates, Nitrates, Weather, Precipitation, Water chemistry, Forest hydrology.

Interception of cloudwater by forests in the Sierra Nevada Mountains may contribute significantly to acidic deposition in the region. Cloudwater sampled in Sequoia National Park had pH values ranging from 4.4 to 5.7. The advance of cold fronts into the Park appears to lead to higher aerosol and gas phase concentrations than are seen under normal mountain-valley circulations, producing higher cloud-water concentrations than might otherwise be expected. Estimates of annual deposition rates of NO3(-), SO4(2-), NH4(+) and H(+) due to cloudwater impaction are comparable to those measured in precipitation. (Author's abstract)
W90-00345

EVALUATION OF PRECIPITATION CHEMISTRY SITING CRITERIA USING PAIRED STATIONS FROM NORTHERN MAIN AND SOUTHEASTERN TEXAS.
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
For primary bibliographic entry see Field 7A.
W90-00347

DEPOSITION OF THE MOST ACIDIFYING COMPONENTS IN THE NETHERLANDS DURING THE PERIOD 1980-1986.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Air Research.
For primary bibliographic entry see Field 5B.
W90-00348

STATISTIC USEFUL FOR CHARACTERIZING PROBABILITY DISTRIBUTIONS, WITH APPLICATION TO RAIN RATE DATA.
Applied Research Corp., Landover, MD.
For primary bibliographic entry see Field 7C.
W90-00349

ISOTOPE STUDIES OF PRECIPITATION AND GROUNDWATER IN THE SIERRA DE LAS CRUCES, MEXICO.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
A. Cortes, and R. N. Farvolden.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 147-153, March 30 1989. 3 fig, 2 tab, 11 ref. NSERC Grant A7712.

Descriptors: *Isotope studies, *Groundwater recharge, *Surface-groundwater relations, *Mexico, *Precipitation, *Water analysis, Springs, Aquifers, Sampling, Groundwater.

An environmental isotope study was carried out on water samples collected from springs, streams, wells and precipitation events in the upper part of the Sierra de las Cruces mountains in Mexico. These mountains form the western flank of the Valley of Mexico in which Mexico City is located and may be an important area of recharge for the aquifers that supply a large portion of the municipal water supply of the city. A local meteoric water line is constructed from the precipitation data by a linear regression technique and is described by delta(D) = 7.95 delta O18 + 11.77. An important feature of these data is the wide spread observed in isotope values throughout the sampling season. These values range from minus 153 to minus 9.0 ppt for deuterium and from minus 20.9 to minus 3.1 ppt for oxygen-18. This wide isotope range cannot be attributed to an altitude effect because all samples were collected at nearly the same elevation. The history of the air masses that generate each precipitation event and variable climatic conditions at the site could be responsible for this effect. Groundwater samples obtained from springs, streams and wells do not show the same ranges of variation as precipitation; most of them are close to the average precipitation values: delta(D) = 70 ppt and delta O18 = minus 10.3 ppt. This value can be considered representative of the isotope composition of the water that may recharge the Valley of Mexico aquifer system in the Sierra de las Cruces area. (Author's abstract)
W90-00360

NUTRIENT FLUX THROUGH A LOBLOLLY PINE FOREST FLOOR USING SIMULATED RAINFALL.
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
For primary bibliographic entry see Field 5B.
W90-00388

CHEMICAL AND PHYSICAL CHARACTERISTICS OF RAINFALL IN VENICE: INFLUENCE OF THE SAMPLING METHOD ON THE RELIABILITY OF THE DATA.
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W90-00560

SAMPLE SIZE REQUIREMENTS FOR ESTIMATION OF THROUGHFALL CHEMISTRY BENEATH A MIXED HARDWOOD FOREST.
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 7A.
W90-00565

MAXIMUM ENTROPY SPECTRA FOR REGIONAL PRECIPITATION ANALYSIS AND FORECASTING.
INTERA Technologies Ltd., Calgary (Alberta).
N. R. Dalezios, and P. A. Tyraskis.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 25-42, July 1989. 8 fig, 1 tab, 22 ref.

Descriptors: *Streamflow forecasting, *Precipitation, *Ontario, *Regional analysis, *Algorithms, *Maximum entropy method, Forecasting, Linear-prediction method, Model studies, Hydrology.

A new algorithm of spectral estimation has been used for the analysis of hydrologic data of the Grand River basin in southern Ontario. This algorithm, which is based on the maximum entropy principle, is a multichannel generalization of the now classical Burg algorithm. In addition, a linear-prediction method based on the obtained prediction error filters (PEF's) has been described for multichannel time series. Employing six multichannel precipitation time series it was possible to show

that the maximum entropy method (MEM) of spectral estimation performs satisfactorily and to confirm previous results on the advantages of the MEM over the classical and other methods. The linear-prediction method yielded satisfactory results for the multichannel precipitation time series. The auto-spectral and cross-spectral densities between the entire multichannel precipitation series including the forecast part and the observed series can be considered as an evaluation of the quality of the prediction. The similarities in the computed spectra indicate that the forecast part is consistent with the prediction model and preserves the basic character of the spectra. Thus the employed prediction methodology justifies the extrapolation potential in regional hydrologic analysis. In catchments there are sequential responses from storm overflows. Cross-spectral techniques are a powerful means for analyzing and modeling such phenomena when adequate data are available. (Author's abstract)
W90-00575

METHOD FOR EVALUATION OF ACIDIC SULFATE AND NITRATE IN PRECIPITATION.
Argonne National Lab., IL. Biological, Environmental, and Medical Research Div.
For primary bibliographic entry see Field 5A.
W90-00643

ATMOSPHERIC DEPOSITION OF PHOSPHORUS AND NITROGEN IN CENTRAL ALBERTA WITH EMPHASIS ON NARROW LAKE.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-00645

ACID RAIN AND ITS EFFECTS ON SEDIMENTS IN LAKES AND STREAMS.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
For primary bibliographic entry see Field 5C.
W90-00722

ACIDIFYING POTENTIAL OF ATMOSPHERIC DEPOSITION IN CANADA.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W90-00810

CHEMICAL COMPOSITION OF RAINFALL IN A CITY OF NORTHERN SPAIN.
Cantabria Univ., Santander (Spain). Dept. of Medical Physics.
For primary bibliographic entry see Field 5B.
W90-00812

TRACE INORGANIC SPECIES IN PRECIPITATION AND THEIR POTENTIAL USE IN SOURCE APPORTIONMENT STUDIES.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W90-00818

VARIATIONS IN RAINWATER QUALITY FROM ROOF CATCHMENTS.
Pertanian Malaysia Univ., Serdang. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5F.
W90-00834

LEAD AND CADMIUM LOADINGS TO THE GREAT LAKES FROM PRECIPITATION.
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
For primary bibliographic entry see Field 5B.
W90-00844

SOIL MOISTURE DEFICITS IN SOUTH-CENTRAL SWEDEN: I. SEASONAL AND REGIONAL DISTRIBUTIONS.
Linkoeping Univ. (Sweden).
For primary bibliographic entry see Field 2G.
W90-00920

STOCHASTIC-DETERMINISTIC NATURE OF AN ELEMENTAL RAINFALL RUNOFF PROCESS.
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-00946

2C. Snow, Ice, and Frost

GLACIERS AND GLACIOLOGY OF ALASKA.
Geological Survey, Tacoma, WA.
R. M. Krimmel, and M. F. Meier.
Anchorage to Juneau, Alaska, July 21-29, 1989. American Geophysical Union, Washington, DC. Field Trip Guidebook T301, 1989. 61p, 44 fig, 47 ref, append.

Descriptors: *Glaciers, *Alaska, *Glaciology, Handbooks, Geohydrology, Glaciation, Glacier surges, Glaciohydrology, Vegetation, Ecology, Social aspects, Ecosystems.

There is nearly 75,000 sq km of glacier ice in Alaska. The major portion is concentrated in the Chugach and St. Elias Ranges through which the field trip traverses. In the region are major advancing and retreating tidewater glaciers, major piedmont glaciers, and surging glaciers. Columbia Glacier is in the early stage of a drastic retreat; Hubbard Glacier is advancing and recently dammed a major fjord; Variegated Glacier recently made a major surge; the glaciers in Glacier Bay underwent a drastic retreat during the last two centuries, resulting in a glacially formed landscape that has only a recent vegetation cover. Southern Alaska has a diverse history, climate, botany, and zoology. Many of the original native cultures of North America came together in Prince William Sound. Russian fur traders and gold miners cam and went, and fishing and tourism dominate the present economy. The climate of southern Alaska is maritime, with substantial precipitation and mild temperatures. The topography has a strong effect on the maritime air masses, resulting in heavy snowfalls and the development of active glaciers on seaward-facing slopes. The succession of vegetation is remarkable, ranging from barren, recently ice-free areas to forest-suffocating muskeg. Southern Alaska also is known for an abundance of marine mammals, including sea otter, seal, sea lion, porpoise, and various species of whales. On land, bear, moose, deer, wolverine, and mountain goat are common; other wildlife is abundant also. (Lantz-PTT)
W90-00077

INCREASED HEAT ABSTRACTION FROM LAKES DURING THE WINTER: METHODS OF ACCELERATING ICE FORMATION ON LAKES IN ORDER TO INCREASE THE AMOUNT OF ENERGY STORED IN THEM DURING THE WINTER (UKAD SUOVARME PA VINTERN: METODER ATT PASKYNDA ISLAGGNINGEN I SJOAR FOR HOGRE ENERGIINNEHALL VINTERTID).
Swedish Council for Building Research, Stockholm.
For primary bibliographic entry see Field 2H.
W90-00277

EVOLUTION OF THE SNOW COVER AND OF THE SOIL HYDROLOGICAL AND THERMAL PROFILES IN A BASIN OF THE LAURENTIDIAN BALSAM FIR FOREST (EVOLUTION DU COUVERT DE NEIGE ET DES PROFILS HYDRIQUE ET THERMIQUE DU SOL DANS UN BASSIN DE LA SAPINIERE LAURENTIDIENNE).
Centre de Recherches en Biologie Forestiere, Departemente des Sciences Forestieres, Universite Laval, Que, G1K 7P4, Canada.
M. Prevost, R. Barry, J. Stein, and A. P. Plamondon.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 343-366, March 30 1989. 11 fig, 4 tab, 20 ref. English summary.

Descriptors: *Quebec, *Forest hydrology, *Snow cover, *Snowpack, *Snowmelt, *Soil water, *Soil moisture retention, Soil profiles, Snow, Soil properties, Soil temperature, Hydrological regime.

Physical characteristics of the snowpack (Depth, water-equivalent, density, temperature) and the thermal and hydrological profiles of the soil have been observed in the balsam fir ecosystem of the Lac Laflamme basin, during three accumulation and snowmelt seasons. A network of 85 sampling points of snow and soil water covering the basin was installed in 1985. Temperatures within the snow cover at different levels in the soil were measured in a station installed on a southerly exposed slope of the basin. As on other forested sites, the high spatial variability of snow water-equivalent (coefficient of variation of 20% during accumulation and up to 56% during snowmelt) is attributed to snow interception by the crowns and to the redistribution on the ground of densified snow from the branches. The statistical analysis shows a higher accumulation of 1-7 cm water equivalent and a faster snowmelt in the upper part of the slopes and on the divide compared to the downslope stations. The detailed study of snow profiles indicates temperature gradients of 0.1-0.2 C/cm and strong density gradients in the snow cover. Because of the thermal properties of snow, the soil temperature remains above -2 C and the freezing depth lies between 40 and 60 cm in spite of air temperatures frequently reaching -30 C in January. The soil hydrological regime would indicate a porous frost during winter. (Author's abstract)
W90-00371

SNOW AVALANCHE-DAMS AND RESULTANT HAZARDS IN GLACIER NATIONAL PARK, MONTANA.
Georgia Univ., Athens. Dept. of Geography.
D. R. Butler.
Northwest Science NOSCAX, Vol. 63, No. 3, p 109-115, May 1989. 25 ref.

Descriptors: *Avalanches, *Avalanche dams, *Montana, *Floods, *Flood discharge, *Hazards, Roads, Bridges, Glacier National Park.

Snow avalanches form natural dams to creek and river flow in Glacier National Park, Montana. Dams are produced primarily by dense wet snow avalanches. Because such dams are unstable and so pose a serious threat to downstream habitats, an analysis was made of these dams in areas of Glacier National Park. Dam formation occurs under conditions of either zonal or meridional flow. Dams may be deposited during winters of high avalanche frequency, but such conditions are not essential. Temporary reservoirs have been impounded by avalanche-dams, causing downstream impoundment and inundation of highways. Calculated potential maximum flood discharges illustrate a hazard of serious proportions, in some cases exceeding all but one known historical spring flood. Three areas in the park are of special concern because of the history of avalanche-dam development across transportation lines. Future avalanche-dams and resultant outburst floods could damage roadways and a major bridge. (Author's abstract)
W90-00621

GEOCHEMICAL STUDIES IN A REMOTE SCOTTISH UPLAND CATCHMENT II. STREAMWATER CHEMISTRY DURING SNOW-MELT.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W90-00809

SNOW COVER OF THE UPPER COLORADO RIVER BASIN FROM SATELLITE PASSIVE MICROWAVE AND VISUAL IMAGERY.
University of Puget Sound, Tacoma, WA.
For primary bibliographic entry see Field 7B.

W90-00917

OVER-WINTER CHEMISTRY OF SUBARCTIC FENS, EASTERN CANADA.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W90-00919

SNOW HYDROLOGY OF THE WAIMAKARIRI CATCHMENT, SOUTH ISLAND, NEW ZEALAND.
McGill Univ., Montreal (Quebec). Dept. of Geography.
R. D. Moore.
Journal of Hydrology (New Zealand), Vol. 27, No. 1, p 44-68, 1988. 9 fig, 1 tab, 70 ref.

Descriptors: *New Zealand, *Flood forecasting, *Snowmelt, *Snow, *Snow accumulation, Weather, Flooding, Streamflow, Hydrologic budget, Variation, Rainfall.

The Waimakariri River drains eastward from the main divide of New Zealand's South Island. Most streamflow derives from the mountainous upper catchment, which is typical of other major catchments in the Canterbury region. Snow accumulation and melt processes are governed by interactions between rapidly changing weather conditions and the steep terrain. Fluctuations in freezing level during storms produce complex spatial and temporal variations of accumulation and melt, resulting in substantial sampling problems. Research and data collection have been hampered by poor access, lack of good stream gaging sites and a paucity of climate data from the mountainous regions. The common coincidence of heavy rainfall with snowmelt complicates the application of water balance methods. Estimates of mean seasonal snowmelt volumes range from nine to fifteen percent of mean annual streamflow. However, snow accumulation at the end of winter can be at least twice the mean in some years. Snowmelt contributions to floods cannot be accurately assessed with currently-available information, but evidence is presented to indicate that snowmelt and rain-on-snow events play a role in the flood hydrology basins in the eastern portions of the catchment, where rainfall intensities are lower than in the areas closer to the main divide. (Author's abstract)
W90-00935

SALT REDISTRIBUTION DURING FREEZING OF SALINE SAND COLUMNS AT CONSTANT RATES.
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2G.
W90-00948

UNCERTAINTIES IN STREAMFLOW MEASUREMENTS UNDER WINTER ICE CONDITIONS, A CASE STUDY: THE RED RIVER AT EMERSON, MANITOBA, CANADA.
SNC Group, Inc., Montreal (Quebec). Power and Heavy Civil Works Div.
For primary bibliographic entry see Field 2E.
W90-00951

ION ELUTION THROUGH SHALLOW HOMOGENEOUS SNOW.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W90-00952

2D. Evaporation and Transpiration

REGIONAL EVAPORATION PROJECT: PROCESSING AND ARCHIVING OF FIELD DATA.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
H. Alksnis, A. K. Chin, P. Daniel, J. D. Kalma, and G. P. Laughlin.
Commonwealth Scientific and Industrial Research Organization, Canberra, Australia. Technical Memorandum 89/2, March 1989. 89p, 20 fig, 10 tab, 11 ref, 16 append.

Descriptors: *Australia, *Evaporation, *Hydrologic budget, Meteorology, Mathematical studies, Climatology, Rainfall, Soil water, Streamflow, Energy.

A regional water balance study is in progress in a 27 sq km catchment near Goulburn, N.S.W. The regional evaporation project aims to develop reliable techniques for estimating daily totals of regional evaporation from standard meteorological surface and upper air data and remote sensing imagery. It is part of a program concerned with the development of improved hydrological process models and management models for rural catchments. An important component of the project is to carry out a program of routine field measurements and observations needed to obtain estimates of evaporation for a range of spatial and temporal scales. These estimates are based on regional water balance techniques, point water balance methods, energy balance/Bowen ratio measurements, several methods based on standard climate data and surface temperature measurements, and planetary boundary layer models. This technical memorandum describes the methods developed for the processing, archiving and use of the field data from the automatic climate stations, the rainfall sites, the streamflow monitoring sites, the soil moisture monitoring program, and the Bowen ratio-energy balance equipment. Individual sections of this memorandum deal with data collection and transfer, data conversion data analysis, archiving of data and data retrieval. (Lantz-PTT)
W90-00080

DATA FOR ASSESSMENT OF EVAPOTRANSPIRATION AND SOIL WATER.
New South Wales Univ., Kensington (Australia). Dept. of Water Engineering.
I. Cordery.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 263-268, 9 ref.

Descriptors: *Hydrologic data collections, *Data collections, *Water resources data, *Soil water, *Evapotranspiration, Data acquisition, Measuring instruments, Model studies, Data storage and retrieval.

Good quality data for the assessment of actual evaporation and transpiration are available at only a few sites in Australia. These are generally at research stations or at capital city meteorological offices. However, data collected at climate and synoptic stations can be used to estimate evapotranspiration, and this type of data is available at a much larger number of sites. To estimate daily or longer period actual evapotranspiration, models are available which accept climate station data. However, for these models to be fully useful some calibration is needed. To undertake this calibration it is usually necessary to have more detailed data, at least for one site within the region. The collection of data suitable for estimation of evapotranspiration and soil water content is not a major problem, but maintenance of the instruments, and more particularly of the collected data, are of much greater concern. There appear to be three major difficulties: (1) the committment of reasonably high level staff who see the importance of the data; (2) the location of the data bank--data held by individuals or even at research stations are often not used because their existence is not known to potential users; (3) data are often stored in such a way that they deteriorate rapidly (poor quality paper, poor storage facilities, inadequate staff or supervision to ensure prompt and careful filing) or are not retrievable due to lack of attention to the need for careful filing and labeling. To provide data for future needs, good quality data needs to be collected and carefully stored now, otherwise in 20 years time when some information is needed, the position will be as poor as it is today. (See also W90-00100) (Author's abstract)
W90-00121

HEAT AND MOISTURE LOSSES OF HEATED RIVERS (WAERME UND FEUCHTEABGABE AUFGEHEIZTER FLUESSE).
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-00182

POPULATION, WATER USE AND GROWTH OF GROUNDNUT MAINTAINED ON STORED WATER. II. TRANSPIRATION AND EVAPORATION FROM SOIL.
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 3F.
W90-00318

UTILITY OF CLIMATIC STATION DATA IN MAKING HOURLY POTENTIAL EVAPOTRANSPIRATION ESTIMATES FOR REMOTE SENSING STUDIES.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
M. Owe.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 99-111, March 30 1989. 6 fig, 2 tab, 22 ref.

Descriptors: *Soil water, *Evapotranspiration, *Meterological data collection, *Hydrologic cycle, *Energy transfer, Climates, Atmospheric water, Clouds, Solar radiation.

Regional estimates of evapotranspiration and soil moisture are often highly inaccurate due to a lack of representative meteorological data with which to calculate the moisture and energy fluxes. A procedure is outline that uses available hourly climatic station data to estimate these moisture and energy fluxes. These hourly climatic station observations and synthesized radiation were compared to detailed meteorological and radiation flux measurements taken up to 100 km away. The two data sets compared well in both trend and magnitude. Solar and net radiation were modeled by using vapor pressure and observed cloud cover and compared well to values observed at the study sites. Hourly potential evapotranspiration estimates were made with both the micromet measurements and the climatic station data for each region, and also compared well. This study was performed for two areas of different climatic conditions, a natural prairie in Kansas and a bare soil in Beltsville, Maryland. Large-area estimates of hourly potential evapotranspiration made with climatic station data may be useful when combined with additional midday satellite observations in the thermal, visible, and near-infrared bands to estimate relevant vegetation parameters, actual evapotranspiration, and soil moisture. (Author's abstract)
W90-00357

SEASONAL CONSUMPTIVE USE OF WATER BY BELL AND CUBANELLE PEPPERS IN SEMIARID AND HUMID COASTAL SITES IN PUERTO RICO.
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
For primary bibliographic entry see Field 2I.
W90-00590

SIMULATION OF WIND-INDUCED WATER CURRENTS.
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2H.
W90-00632

2E. Streamflow and Runoff

INTEGRATION OF RUNOFF AND RECEIVING WATER MODELS FOR COMPREHENSIVE WATERSHED SIMULATION AND

ANALYSIS OF AGRICULTURAL MANAGEMENT ALTERNATIVES.
Anderson-Nichols and Co., Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5G.
W90-00014

DISTRIBUTION OF MICROORGANISMS AND SELECTED METALS IN MINE DRAINAGE, STREAM WATER, AND SEDIMENT.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-00040

DROUGHT ASSESSMENT THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA.
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
T. A. McMahon, and R. Srikanthan.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 119-129, 1 fig, 5 tab, 16 ref.

Descriptors: *Hydrologic data collections, *Data collections, *Water resources data, *Drought, *Stochastic hydrology, *Rainfall, *Streamflow, *Data interpretation, *Rainfall-runoff relationships, Agricultural hydrology, Water shortage, Mathematical analysis, Hydrologic budget, Mathematical studies.

The efficient management of an agricultural system or the operation of a water supply scheme requires knowledge about critical droughts, such as their length, severity and frequency of occurrence. Foley's drought index and residual mass curves are calculated and used to examine drought severity. Several theoretical distributions are fitted to drought events of up to one year's duration and the average recurrence intervals proposed and used to obtain the average recurrence interval of events of duration longer than one year. These methods are applied to five river basins in Victoria. Data from these applications indicate that the average recurrence intervals of the rainfall for the worst drought on record tend to be slightly larger than the corresponding inflow events. Recurrence intervals clearly indicate that a 12-month drought (1982/83) was a rare event. The mean of the recurrence intervals of rainfall over the five catchments was about 65 years and that of inflow was about 120 years. Nevertheless, the likelihood or probability of an event of this magnitude occurring again in the next decade is between 8% and 15%. This same procedure can be applied to rainfall and inflow data from Southeast Asia, as hydrologic data in that region exhibit low variability (annual coefficient of variability 0.5). Data requirements would be modest--about 20 to 30 years of data. (See also W90-00100) (Lantz-PTT)
W90-00109

DECISION MAKING USING A DROUGHT SEVERITY INDEX.
Australian National Univ., Canberra. Dept. of Geography.
For primary bibliographic entry see Field 6A.
W90-00110

INDIANA WATER QUALITY 1986: MONITOR STATION RECORDS--RIVERS AND STREAMS.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN 46224.
1986. 139p, 2 fig, 1 tab.

Descriptors: *Rivers, *Streams, *Indiana, *Water quality, *Data collections, Physical properties, Water analysis, Bacterial analysis, Chemical analysis, Plankton, Radiochemical analysis.

This is the 29th annual water quality report on the major surface waters of Indiana. In April 1957, the Division of Sanitary Engineering, Indiana State Board of Health, established 49 sites for the biweekly collection of samples for physical, chemical, and bacteriological analyses, and 10 of the stations were sampled for radiological analyses. Various changes and improvements have been made since the program was established in 1957. On April 1, 1986, the Indiana Department of Environmental Management assumed this program's duties. This report details the analyses conducted on the 105 stations that were included in the total 1986 program. Physical, chemical, and bacteriological analyses were made on samples collected from all 105 of these stations and plankton analyses from 41 of the stations. Radiological data may be obtained by contacting the Indiana State Board of Health. (Lantz-PTT)
W90-00127

FORMULATION OF WATER QUALITY MODELS FOR STREAMS, LAKES, AND RESERVOIRS: MODELER'S PERSPECTIVE.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2H.
W90-00145

FLOODS OF NOVEMBER 1978 TO MARCH 1979 IN ARIZONA AND WEST-CENTRAL NEW MEXICO.
Geological Survey, Menlo Park, CA.
B. N. Aldridge, and T. A. Hales.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2241, 1984. 149p, 11 fig, 10 tab, 2 plates, 38 ref.

Descriptors: *Floods, *Gila River, *Little Colorado River, *Arizona, *New Mexico, River basins, Flood peak, Flooding, Flood damage, Economic aspects, Salt River, Verde River, Agua Fria River, Groundwater level.

Severe flooding occurred in parts of the Little Colorado and Gila River basins as a result of a storm that occurred December 17-20, 1978. The central highlands received 3 to 10 inches of precipitation that was augmented by snowmelt to altitudes of 10,000 ft. This flood caused 12 deaths and damage that was probably in excess of 150 million dollars in Arizona and west-central New Mexico. Damage was estimated to be 51.8 million dollars in Maricopa County, Arizona. The flood crest on the Gila River in December 1978 moved from Redrock, New Mexico, to Duncan, Arizona, in about 6 hours, which is more rapid than during other recent floods, but is comparable to the traveltime recorded in 1941. Water conservation reservoirs on the Gila, Salt, Verde, and Agua Fria Rivers and a flood control reservoir on the Gila River had a major influence on the magnitude of floods downstream from the reservoirs. Major flooding was averted along the Gila River between Collidge Dam and Salt River. Minor flooding occurred along the Gila River downstream from San Pedro River. Floods in central and western Maricopa County, Arizona, were caused by the release of water from full reservoirs on the Salt, Verde, and Agua Fria Rivers, but peak discharges and duration of the floods were much less than would have occurred if the reservoirs had not been in place. Flow continued in the Salt River through Phoenix until May 1979. Water was released from Painted Rock Dam until January 1980. The prolonged flows and reduction in groundwater pumping caused groundwater levels to rise appreciably in many areas. (Lantz-PTT)
W90-00193

CHANGES IN FLOOD RESPONSE OF THE RED RIVER OF THE NORTH BASIN, NORTH DAKOTA-MINNESOTA.
Geological Survey, Lakewood, CO.
J. E. Miller, and D. L. Frink.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2243, 1984. 103p, 17 fig, 13 tab, 66 ref, 11 append.

Descriptors: *North Dakota, *Minnesota, *Red River, *Flood frequency, *Flood peak, Land use, Drainage, Hydrology, Flood discharge.

The magnitude and frequency of large floods that have occurred in recent years in the basin of the Red River of the North have caused concern that land use changes and man-made drainage have increased flooding. A study was undertaken to determine whether any changes in flood response of the basin could be documented. A review of the hydrologic setting, previous floods, flood control measures, and probable effects of land use changes shows that the flooding problem of the Red River basin is complex hydrologically, highly variable historically, and follows a regional pattern. Therefore, a change in flood response of the basin is difficult to identify. The flood frequency, normalized-hydrograph, double-mass, and regression analyses show little indication of significant change in flood response of the Red River basin at locations on the main stem. However, the large variation in flood discharges may mask or dwarf small changes in response. (Author's abstract)
W90-00194

TECHNIQUES FOR ESTIMATING STREAMFLOW CHARACTERISTICS IN THE EASTERN AND INTERIOR COAL PROVINCES OF THE UNITED STATES.
Geological Survey, Harrisburg, PA.
K. L. Wetzel, and J. M. Bettandorff.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2276, 1986. 80p, 2 fig, 4 tab, 2 plates, 8 ref.

Descriptors: *Streamflow, *Flood peak, *Hydrologic data collections, Regression analysis, Flow profiles, Flow duration, Drainage, Low flow, Coal mines, Data interpretation.

Techniques are presented for estimating various streamflow characteristics, such as peak flows, mean monthly and annual flows, flow durations, and flow volumes, at ungaged sites on unregulated streams in the U.S. Eastern Coal region. Streamflow data and basin characteristics for 629 gaging stations were used to develop multiple linear regression equations. Drainage area is an independent variable common to all equations. Other variables needed, are mean annual precipitation, mean basin elevation, main channel length, basin storage, main channel slope, and forest cover. A ratio of the observed 50% to 90% flow durations was used in the development of relations to estimate low flow frequencies in the Eastern Coal Province. Relations to estimate low flows in the Interior Coal Province are not presented because the standard errors were > 0.7500 log units and considered to be of poor reliability. (Lantz-PTT)
W90-00203

MAGNITUDE AND FREQUENCY OF HIGH FLOWS OF UNREGULATED STREAMS IN KANSAS.
Geological Survey, Lawrence, KS. Water Resources Div.
P. R. Jordan.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2280, 1986. 35p, 7 fig, 6 tab, 16 ref.

Descriptors: *Flood frequency, *High flow, *Flow profiles, *Streamflow, *Kansas, Rainfall intensity, Drainage area.

Information on high flow magnitude and frequency is needed for hydrologic evaluation of such factors as flood control storage and dam safety. High flow information given is for streamflows unaffected by major regulation, such as by large reservoirs. High flow magnitude and frequency data are given for 91 streamflow gaging stations throughout Kansas. Results of frequency calculations are given for durations of high flow of 1, 3, 7, 15, 30, 60, 90, 120, and 183 consecutive days. Accuracy of the magnitude frequency values is influenced by the variability of flow, the number of years of flow record, and the recurrence interval calculated. High flow magnitude and frequency for ungaged sites can be estimated from regression equations using significant drainage basin charac-

teristics of contributing-drainage area; 50-year, 24-hour rainfall; and free water surface evaporation. Standard errors of estimate for ungaged sites on ungaged streams range from 31% to 49%, generally increasing with recurrence interval. (Author's abstract)
W90-00204

HYDROLOGIC UNIT MAPS.
For primary bibliographic entry see Field 7C.
W90-00207

ANALYSIS OF SURFACE-WATER DATA NETWORK IN KANSAS FOR EFFECTIVENESS IN PROVIDING REGIONAL STREAMFLOW INFORMATION.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7A.
W90-00213

APPLICATION OF THE PRECIPITATION-RUNOFF MODEL IN THE WARRIOR COAL FIELD, ALABAMA.
Geological Survey, Tuscaloosa, AL.
For primary bibliographic entry see Field 2A.
W90-00214

QUANTITATIVE ASSESSMENT OF THE SHALLOW GROUND-WATER FLOW SYSTEM ASSOCIATED WITH CONNETQUOT BROOK, LONG ISLAND, NEW YORK.
For primary bibliographic entry see Field 2F.
W90-00216

STREAMFLOW, SEDIMENT TRANSPORT, AND NUTRIENT TRANSPORT AT INCLINE VILLAGE, LAKE TAHOE, NEVADA, 1970-73.
Geological Survey, Carson City, NV.
P. A. Glancy.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2313, 1988. 53p, 33 fig, 16 tab, 23 ref.

Descriptors: *California, *Streamflow, *Sediment transport, *Nutrients, Lake Tahoe, First Creek, Second Creek, Wood Creek, Third Creek, Incline Creek, Runoff, Snowmelt, Streams, Erosion, Catchment areas.

Five principal creeks, First Creek, Second Creek, Wood Creek, Third Creek, and Incline Creek, having a cumulative drainage of 17.8 sq mi, furnished a yearly average of about 15,000 acre-ft of runoff, mainly snowmelt, to Lake Tahoe during the 1970-73 water years. Annual runoff from the individual streams ranged from 460 to 7,070 acre-ft, and discharges ranged from 0.2 to 110 cu ft/sec. During the 4 years, the five streams delivered to Lake Tahoe 31,000 tons of sediment, which averaged about 75% percent gravel and sand, 15% silt, and 10% clay. Annual cumulative sediment load for the five creeks ranged from 1,500 to 11,000 tons; individual streams furnished 20 to 5,200 tons annually. Measured sediment transport at the stream mouths ranged from 1 to 13,200 mg/L and from 0.001 to 1,420 tons/day; sediment concentrations up to 63,200 mg/L were measured at upstream tributary sites. Estimated annual sediment yields of principal drainage basins ranged from 3 to 930 tons/sq mi from undeveloped areas and from 26 to 5,000 tons/sq mi from developed areas; yields for developed areas appeared to average about 10 times those of undeveloped areas, and roadways apparently were the major source. Erosion disequilibrium caused by pre-study flash floods on two of the creeks continues to manifest itself through high natural sediment yields. The Second Creek flood of 1967 yielded about 75,000 tons of sediment in one afternoon. Fluvial nutrient transport seems quantitatively related to magnitudes of sediment and water transport. Movement rates of organic nitrogen and particulate phosphorus were greater than rates of other nutrient species moving to the lake. (Author's abstract)
W90-00219

SIMULATION OF FLOOD HYDROGRAPHS FOR GEORGIA STREAMS.
Geological Survey, Doraville, GA.
E. J. Inman.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2317, 1987. 26p, 14 fig, 13 tab, 13 ref.

Descriptors: *Flood hydrographs, *Simulation analysis, *Hydrographs, *Georgia, Streamflow, Mathematical analysis, Flood peak, Regression analysis, Computer models, Floods, Model studies, Unit hydrographs.

A method for simulating the flood hydrographs at ungaged sites in Georgia is presented. The O'Donnell method was used to compute unit hydrographs and lagtimes for 355 floods at 80 gaging stations. An average unit hydrograph and an average lagtime were computed for each station. These average unit hydrographs were transformed to unit hydrographs having durations of one-fourth, one-third, one-half, and three-fourths lagtime, then reduced to dimensionless terms by dividing the time by lagtime and the discharge by peak discharge. Hydrographs were simulated for these 355 floods and their widths were compared with the widths of the observed hydrographs at 50% and 75% of peak flow. The dimensionless hydrograph based on one-half lagtime duration provided the best fit of the observed data. Multiple regression analysis was used to define relations between lagtime and certain physical basin characteristics; drainage area and slope were found to be significant for the rural-stream equations and drainage area, slope, and impervious area were found to be significant for the Atlanta urban-stream equation. A hydrograph can be simulated from the dimensionless hydrograph, the peak discharge of a specific recurrence interval, and the lagtime obtained from regression equations for any site in Georgia having a drainage area of < 500 sq mi. For simulating hydrographs at sites having basins larger than 500 sq mi, the U.S. Geological Survey computer model CONROUT can be used. The Product of CONROUT is a simulated discharge hydrograph for the downstream site that has a peak discharge of a specific recurrence interval. (Author's abstract)
W90-00221

SYNOPTIC AND MESO-ALPHA SCALE METEOROLOGY OF WYOMING FLASH FLOODS.
National Weather Service Forecast Office, Cheyenne, WY.
For primary bibliographic entry see Field 2B.
W90-00237

INTERDISCIPLINARY PROCESS FOR PROTECTING INSTREAM FLOWS.
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 6A.
W90-00334

OVERLAND FLOW MODELING: CAN RAINFALL EXCESS BE TREATED AS INDEPENDENT OF FLOW DEPTH.
Technische Univ., Vienna (Austria). Inst. fuer Hydraulik Gewasserkunde und Wasserwirtschaft.
B. H. Schmid.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 1-8, March 30 1989. 2 fig, 3 tab, 20 ref.

Descriptors: *Overland flow, *Surface water, *Rainfall-runoff relationships, *Model studies, *Hydrologic models, Storm runoff, Storm water, Simulation, Percolation.

The modeling of overland flow by means of the kinematic wave has been a recognized technique in hydrology for about two decades. To determine the order of magnitude of errors that are to be expected as a consequence of neglecting overland flow depth, simulations were carried out to determine the effect of neglecting surface water depth in overland flow computations. The results of simulation runs for Guelph loam showed that although maximum errors related to infiltration rate keep below 4%, the same errors will be up to, but not exceeding 11% in any of the examples. If, however, the amount of surface runoff is very small compared to infiltration, even small errors may constitute a large percentage of rainfall excess. Since such situations will not normally be important in storm runoff simulations, the usual neglect of water depth of overland flow modelers appears justified. (Friedmann-PTT)
W90-00350

CHARACTERIZING FLOOD-PRONE RICE AREAS AND PREDICTING FLOODING HAZARDS.
International Rice Research Inst., Los Banos, Laguna (Philippines). Water Management Dept.
R. C. Undan, S. I. Bhuiyan, and M. M. Agua.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 297-307, March 30 1989. 4 fig, 2 tab, 4 ref.

Descriptors: *Philippines, *Flood forecasting, *Rice, *Agricultural hydrology, *Flood plains, *Model studies, *Flood basins, Drainage area, Crop yield, Crop production, Hydrologic models.

A methodology to characterize flood-prone rice-growing areas and to predict their flooding hazards in rice culture was pursued using limited and easily-generated hydrologic data from a river flood plain. A computer model established the relationships of a given flooding event with the areal extent of affected area and depth of flood water and period of crop submergence at different farm elevations. These relationships were translated into a monograph for their easy use. The model was also used to assess benefits that may be achieved if drainage rate of the basin is increased through infrastructural improvements. It can be expanded to estimate rice yields and production losses in the basin due to given flooding events. (Author's abstract)
W90-00368

WATER FLOW IN A HUMMOCKY LANDSCAPE IN CENTRAL SASKATCHEWAN, CANADA: I. DISTRIBUTION OF WATER AND SOILS.
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
B. J. Zebarth, and E. De Jong.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 309-327, March 30 1989. 3 fig, 9 tab, 30 ref.

Descriptors: *Geomorphology, *Infiltration, *Saskatchewan, *Overland flow, *Hydrological regime, *Soil water, *Drainage patterns, *Surface water, *Drainage areas, Catchment areas, Watersheds, Hydraulic conductivity, Leaching, Aeration zone, Soil horizons.

Water flow in a hummocky landscape is highly variable in time and space. A classification system based on landscape surface form is demonstrated to delineate areas with similar hydrologic properties. The study was conducted in a hummocky landscape with a closed drainage pattern in the Black soil zone of Saskatchewan. The sites consisted of three closed drainage basins, 80-150 m across, surrounding individual temporary sloughs. The distribution of water in the landscape was inferred from in situ electrical conductivity and soil morphological properties including thickness of A and eluviated horizons and depth to calcium carbonate. In situ electrical conductivity was strongly correlated with the depth of water in the top 1.2 m of the soil. The sites were divided on the basis of landscape surface form into lower slope, upper slope and saddle positions, which accounted for 30, 50 and 20% of the cultivate areas of the basins, respectively. The lower slope positions were well-leached of soluble salts and had high water contents, thick A horizons, gleyed and/or eluviated horizons, and thick zones of calcium carbonate depletion. The upper slope positions had limited leaching of soluble salts, low water contents, thin A horizons, lacked eluviated horizons, and calcium carbonate was present either at shallow depths or at the soil surface. The properties of the saddle positions were intermediate between the upper and lower slope positions. The spatial distribution of water in the landscape persisted over time due to the redis-

tribution of water in the landscape by topography. (Author's abstract)
W90-00369

OBSERVATIONS ON THE DOWNSTREAM MOVEMENT OF JUVENILE FISHES IN THE ATREK RIVER.
T. P. Savenkova, and A. Y. Asanov.
Journal of Ichthyology JITHAZ, Vol. 28, No. 2, p 105-112, 1988. 4 fig, 1 tab, 14 ref.

Descriptors: *Stream biota, *Fish populations, *Fish behavior, *Fish migration, Migration, Carp, Species composition, Spawning.

Observations were recorded on the downstream movement of juvenile vobla, Rutilus rutilus caspicus, carp Cyprinus carpio, Caspian silverside, Atherina mochon pontica, and the goby, Knipowitschia caucasia, in the Atrek River, USSR. Factors affecting temporal changes in species composition, as well as diurnal rhythms of migrational characteristics and the behavior of juveniles in relation to flow volume and flow regulation, were investigated. It was found that juvenile carp and vobla predominate in the Atrek's lower reaches (up to 72.2-99.9%). The numbers of euryhaline species--silverside and goby--increase in years when the abundance of adult vobla is reduced and there is a high and lengthy flooding of the Atrek spawning grounds. Juveniles descend from the Atrek's improved spawning grounds beginning in early to mid May; this continues until the complete drying of the flooded area, which typically occurs in June. At present, the length of the descent depends not only on the annual water level, but also on river regulation. The juvenile downstream migration to the lower reaches of the Atrek occurs mainly around the clock as is characteristic for turbid rivers. A change in the hydrology of the lowlands produced a change in the age and size/weight composition of the juveniles. At present, in years with retention of water on the spawning grounds, juvenile vobla and carp descend mainly in the migratory stage of development. A length retention of juveniles on the spawning grounds with inadequate depths in the flooded areas results in retardation of growth. (Friedmann-PTT)
W90-00376

IN SITU NUTRIENT ENRICHMENT EXPERIMENTS WITH PERIPHYTON IN AGRICULTURAL STREAMS.
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 4C.
W90-00401

CENTRAL ASIAN IRRIGATION CANALS AND SOME ASPECTS OF THEIR ALGAL FLORA.
Tashkent State Pedagogical Inst. Nizami SSR. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W90-00408

CORRESPONDENCE BETWEEN THE DISTRIBUTION OF FISH ASSEMBLAGES IN WISCONSIN STREAMS AND OMERNIK'S ECOREGIONS.
Wisconsin Dept. of Natural Resources, Fitchburg.
For primary bibliographic entry see Field 2H.
W90-00520

ISOLATION OF SAPROLEGNIACEAE FROM TIGRIS RIVER AND NOTES ON THEIR OCCURRENCE IN WINTER SEASON.
Biological Research Center, Baghdad (Iraq). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W90-00545

PREDICTION OF SOLUBLE PHOSPHORUS TRANSPORT IN AGRICULTURAL RUNOFF.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W90-00567

PARTIAL DURATION SERIES METHOD WITH A FIXED NUMBER OF PEAKS.
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 1-9, July 1989. 2 tab, 9 ref.

Descriptors: *Streamflow forecasting, *Model studies, *Stream discharge, *Partial duration series model, *Flow characteristics, *Flood peak, Quantile estimates, Flow pattern.

The estimation of a T-year event from a partial duration series can be done by either abstracting all peaks over a fixed threshold (Method 1) or by selecting the M highest peaks (Method 2). For the particular partial duration series model investigated in this note the two methods perform equally well in terms of asymptotic efficiency when unknown model parameters are estimated by the method of maximum likelihood (ML). In the situation of a fixed number of peaks (Method 2) the asymptotic expressions for the accuracy of a quantile estimate can already be used for moderate M (e.g. M=20). The ML-method leads to slightly biased quantile estimates. When Method 2 is used to abstract the peak values from the historic record, an unbiased quantile estimate can be obtained from the minimum variance unbiased estimators of the model parameters. This unbiased estimate has generally slightly larger mean-square error than the ML-estimate. (Author's abstract)
W90-00573

STANDING CROP AND PROCESSING OF RAINFOREST LITTER IN A TROPICAL AUSTRALIAN STREAM.
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-00593

BIOGEOCHEMICAL SURVEY OF RIVERS AND STREAMS IN THE MOUNTAINS AND FOOT-HILLS PROVINCE OF ARCTIC ALASKA.
University Coll. of North Wales, Bangor. School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W90-00594

DISTRIBUTION AND ABUNDANCE OF FISHES ASSOCIATED WITH SUBMERSED AQUATIC PLANTS IN THE POTOMAC RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W90-00619

SNOW AVALANCHE-DAMS AND RESULTANT HAZARDS IN GLACIER NATIONAL PARK, MONTANA.
Georgia Univ., Athens. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-00621

VELOCITY REDISTRIBUTION IN MEANDERING RIVERS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. Johannesson, and G. Parker.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1019-1039, August 1989. 8 fig, 2 tab, 28 ref, 2 append. National Science Foundation Grant Nos. MSM-8311721-02 and INT-8412678.

Descriptors: *Model studies, *Channel morphology, *Flow velocity, *River flow, *River mechanics, *Meanders, Bank erosion, Estimating equations, Flow characteristics.

The fluvial processes encountered in natural meandering rivers have long intrigued engineers. Not only does the geometric shape of river bends give rise to a complicated three-dimensional flow field, but, equally important, the flow field reshapes the bends through the process of bank erosion. An analytical model for calculating the lateral distribution of the depth-averaged primary flow velocity in meandering rivers is presented. A small perturbation approach is used to linearize the governing equations. The well-known 'moment method,' commonly used to solve the concentration distributions, is then used to obtain an approximate solution. This makes it possible to take into account the convective transport of primary flow momentum by the secondary flow. This oft-neglected influence of the secondary flow is shown to be an important cause of the redistribution of the primary flow velocity. The model, when tested with the laboratory data, gives substantially better results than several previous models. (Author's abstract)
W90-00627

COLIFORM DETECTION FROM RIVER WATERS: COMPARISON BETWEEN MPN AND MF TECHNIQUES.
Bologna Univ. (Italy). Ist. di Microbiologia Agraria e Tecnica.
For primary bibliographic entry see Field 5A.
W90-00646

SUBTIDAL ADVECTIVE WATER FLUX AS A POTENTIALLY IMPORTANT NUTRIENT INPUT TO SOUTHEASTERN U.S.A. SALT-MARSH ESTUARIES.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W90-00681

SPATIAL VARIATION IN FISH COMMUNITIES IN TWO SOUTH-WESTERN AUSTRALIAN RIVER SYSTEMS.
Western Australia Univ., Nedlands. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-00692

SUCCESSIONAL CHANGES IN HABITAT CAUSED BY SEDIMENTATION IN NAVIGATION POOLS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W90-00697

ENTRAINMENT OF SEDIMENTS BY THE TURBULENT FLOW OF WATER.
Sydney Univ. (Australia). School of Civil and Mining Engineering.
For primary bibliographic entry see Field 2J.
W90-00699

SEDIMENT TRANSPORT IN AN INLAND RIVER IN NORTH QUEENSLAND.
Queensland Water Resources Commission, Brisbane (Australia).
For primary bibliographic entry see Field 2J.
W90-00702

DYNAMIC CHARACTERISTICS UNDER LOW FLOW CONDITIONS IN THE WAKOOL RIVER, N.S.W.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
B. B. Sharp, and K. S. M. Herat.
Hydrobiologia HYDRB8, Vol. 176/17, p 93-98, July 3, 1989. 5 fig, 6 ref.

Descriptors: *Saline-freshwater interfaces, *River flow, *Wakool River, *Saline water, *Australia, *Entrainment, *Mixing, *Low flow, Stratification, Flow.

Measurements are reported for low river flow at one of a number of deep pools (Glenholme Hole in the Wakool River, Australia) which hold high concentrations of salt water. The Wakool River may be regarded as an ancestral branch of the River Murray in Australia. During low flows,

strong density stratification over deep saline ponds affects the flow (and transport) characteristics. A study using a special dynamic flow measuring device found that there was further layering of the flow. This means that the low flow description, as it effects transports of material, is rather more complex than expected; it indicates that parametrization of the mixing for different flow rates in rivers will be necessary. The ability to measure low flows with a dynamic content is confirmed, although the field support needed to perform such measurements should not be underestimated. The flow conditions suggest a three-layered system at the saline pools and imply that any entrainment of salinity from the pools is not immediately relatable to the net downstream flow. That is, the motions of any intermediate layer would act as a buffer against the entrainment by the upper freshwater flow when this is low. (Miller-PTT)
W90-00703

DETERMINATION OF HEAVY METALS IN WATER, SUSPENDED MATERIALS AND SEDIMENTS FROM LANGAT RIVER, MALAYSIA.
National Univ. of Malaysia, Bangi. Dept. of Nulcear Science.
For primary bibliographic entry see Field 5B.
W90-00714

TRACE ELEMENTS IN SUSPENDED PARTICULATE MATTER FROM THE YARRA RIVER, AUSTRALIA.
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
For primary bibliographic entry see Field 5B.
W90-00715

GEOCHEMICAL CHARACTERISTICS OF HEAVY METALS IN THE XIANGJANG RIVER, CHINA.
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 5B.
W90-00716

INORGANIC AND METHYL MERCURY IN INLAND WATERS.
Cagliari Univ. (Italy). Ist. di Igiene e Medicina Preventiva.
For primary bibliographic entry see Field 5B.
W90-00825

FRACTIONATION OF PARTICULATE MATTER, THE TRACE METALS CU, CD, AND ZN, AND LIPIDS IN FOAM AND WATER BELOW NIAGARA FALLS.
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W90-00838

RESPONSE OF MUSKINGUM EQUATION TO STEP INPUT.
Detroit Water and Sewerage Dept., MI.
M. A. Gill.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 736-738, August 1989. 10 ref, append.

Descriptors: *Muskingum equation, *Routing, *Flood routing, *River forecasting, *Flood flow, Flow channels, River mechanics, Mathematical equations, Flood hydrographs, Flood plain management.

The Muskingum method of flood routing in river channels is quite popular with hydrologists. The method came under increasing scrutiny and investigation recently, and methods of its application are elucidated in a number of papers. One fundamental aspect, however, is still not satisfactorily treated. The conventional solution of the Muskingum equation, which predicts negative outflows for initial small values of time, is indeed incorrect. A solution of the Muskingum equation for a step input is presented using the Laplace transform method. The solution is realistic and obviates the negative outflows for initial small values of time. A physical inflow flood can now be divided into a number of rectangular strips, and the outflow hydrograph can be synthesized by convolution. Such an outflow hydrograph will not have negative ordinates. (Fish-PTT)
W90-00896

INFLUENCE OF THE 1982-83 DROUGHT ON RIVER FLOWS IN HAWKE'S BAY.
Hauraki Catchment Board, Te Aroha (New Zealand).
W. Harrison.
Journal of Hydrology (New Zealand), Vol. 27, No. 1, p 1-125, 1988. 12 fig, 4 tab, 24 ref.

Descriptors: *New Zealand, *Drought, *Streamflow, Stream gages, Flow duration, Flow measurement, Hawkes Bay.

During the summer of 1982-83 the Hawke's Bay region, North Island, New Zealand, experienced a very severe drought, resulting from the development of an extensive, persistent El Nino-Southern Oscillation event in the equatorial Pacific Ocean. During February and March 1983 low flows in Hawke's Bay rivers were gauged on the Mohaka, Esk, Tutaekuri and Nagaruroro Rivers. Flow duration curves, variability indices and recession curves were used to check data consistency and indicate any regional variation. The return periods for the event from flow records at river stations ranged from seven to 40 years. Data collected during the drought were used to compile a map of one-day minimum flows for a one-in-ten year return period. Specific discharges obtained during this survey were found to be consistent with those from low flows studied elsewhere in New Zealand. (Author's abstract)
W90-00932

SNOW HYDROLOGY OF THE WAIMAKARIRI CATCHMENT, SOUTH ISLAND, NEW ZEALAND.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-00935

AIR-WATER GAS TRANSFER IN OPEN CHANNELS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and M. J. Halverson.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1783-1794, August 1989. 7 fig, 3 tab, 25 ref.

Descriptors: *Air-water interfaces, *Open-channel flow, *Aeration, Flumes, Upwelling, Vortices.

Laboratory flume experiments on waterside-controlled gas transfer, such as reaeration, are described. The experiments are well described by Danckwerts' surface renewal model for open-channel flow. The primary cause of surface renewal in flumes is proposed to be the upwelling of large streamwise vortices and is documented by relating prior velocity measurements of these vortices and observations of surface upwellings to gas transfer measurements. A dimensionless liquid film coefficent (Stanton number) is related to a shear Peclet number and a shear Reynolds number. The shear Reynolds number represents the effectiveness of the large streamwise vortices in penetrating the water surface. The proposed hypothesis is essentially a large streamwise vortices in penetrating the water surface. The proposed hypothesis is essentially a large eddy model, except that coherent structures in the flow have been identified as the predominant mechanism of surface renewal, rather than random turbulence. The coherent structures of importance to surface renewal are the large streamwise vortices with a size similar to the depth that occurs in an open channel flow. Thus a streamwise vortex model of gas transfer in open channels is developed. The implications of this model on the prediction of gas transfer in open channels is discussed. (Author's abstract)
W90-00944

STOCHASTIC-DETERMINISTIC NATURE OF AN ELEMENTAL RAINFALL RUNOFF PROCESS.
Calgary Univ. (Alberta). Dept. of Civil Engineering.
I. Muzik, and A. K. Beersing.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1805-1814, August 1989. 15 fig, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall intensity, *Flood peak, *Model studies, Stochastic models, Kinematic wave theory.

The transformation process of probability density functions of rainfall intensity into the densities of peak discharge is investigated for the case of runoff from a uniformly sloping impervious plane. Normal, two-parameter gamma, and exponential distributions of rainfall intensity are used in Monte Carlo simulations to obtain densities of peak discharge. The kinematic wave and experimentally derived relations are utilized to compute the peak discharge. The kinematic wave and experimentally discharge is shown to be the outcome of deterministic relationships operating on stochastic inputs. Conclusions are made about the effect of runoff plane physical characteristics on the probability density of peak discharge. In natural basins one would expect that a sudden increase in a basin storage capacity due to overbank flow, storage in flat and swampy areas, underground storage, etc., may similarly result in a negative skew of the peak flows. Differences between densities of the rainfall intensity and the derived peak discharge in terms of their means, coefficients of variation and skewness will be greater for slowly responding runoff planes than for planes with a fast response. That is, runoff planes having flat slopes and large hydraulic resistance will generally produce more skewed distributions of peak discharge and lower values of the mean subjected to the same rainfall inputs. This result may be taken into account when plotting maps of regional coefficients of skewness which are assumed to be geographically dependent. Experimental results indicate that the exponent m can become less than one. This result appears correct because observed hydrographs are characterized by an infection point on the rising limb. Hydrologic models based on the kinematic wave solution of overland flow due to rainfall when used in Monte Carlo simulation can be expected to have the tendency to overestimate the coefficient of skewness of peak discharge. Linear models such as the rational and unit hydrograph methods will have the tendency to underestimate in Monte Carlo simulation. Finally, the relations obtained for the elemental rainfall runoff process in this study do not follow any of the fixed relations for two-parameter distributions typically used in flood frequency analysis. Such as the log-Pearson type III distribution, would be needed to account for the variation. (Author's abstract)
W90-00946

UNCERTAINTIES IN STREAMFLOW MEASUREMENTS UNDER WINTER ICE CONDITIONS, A CASE STUDY: THE RED RIVER AT EMERSON, MANITOBA, CANADA.
SNC Group, Inc., Montreal (Quebec). Power and Heavy Civil Works Div.
P. M. Pelletier.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1857-1867, August 1989. 5 fig, 1 tab, 23 ref.

Descriptors: *Streamflow, *Data acquisition, *Stream gages, *Gages, *Gaging, *Measuring instruments, *Ice cover, Comparison studies, Red River, Manitoba.

Computed streamflows on the Red River at Drayton North Dakota, United States, have been generally higher under winter conditions than computed streamflows on the Red River at Emerson in Manitoba, Canada. The station at Drayton is located 85 km upstream from Emerson. Moreover, historically, the U.S. Geological Survey (USGS) has measured higher streamflows under ice conditions than

the Water Survey of Canada (WSC) on the Red River at Emerson. The difference between their discharge measurements under ice conditions is generally between +10 and 20%. To explain these differences, field and laboratory experiments were concluded in 1986, which included an international field metering program at Drayton and Emerson, rating of current meters and suspension equipment at national calibration services in Canada and the United States, and testing of current meters in flowing water. Through the analysis of the field and calibration data it was determined that significant differences exist between a current meter rated on rod and on cable suspension, and that this suspension effect is responsible for the large differences in measurements between the USGS and WSC. Changes in discharge measurement techniques under ice conditions are suggested, including the sampling of vertical velocity curves and increasing the time of exposure for current meter observations. Several investigations are suggested to improve the overall quality of streamflow records for the winter ice period. (Author's abstract)
W90-00951

SOURCE AREAS, DRAINAGE DENSITY, AND CHANNEL INITIATION.
California Univ., Berkeley. Dept. of Geology and Geophysics.
D. R. Montgomery, and W. E. Dietrich.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1907-1918, August 1989. 15 fig, 3 tab, 40 ref.

Descriptors: *Drainage density, *Channel flow, *Simulation analysis, *Geomorphology, *Erosion, Catchment areas, California.

An analysis of channel head locations provides insight into control on drainage density, the response of landscapes to climatic change, and the delineation of source areas for channel network simulations. Channel heads and colluvial deposits were mapped in a roughly 2 km2 area near San Francisco, California, and, although channel heads are located within colluvial deposits in hollows, many such deposits do not support channel heads. Channel heads were classified as either gradual or abrupt. For either type of channel head, the channel reach immediately downslope may be contiguous with the channel network or may consist of a series of short discontinuous channel segments. The local valley slope at the channel head is inversely related to both source area and source-basin length as well as to the contributing area/unit contour length at the channel head. In contrast, valley slope does not vary with drainage area upslope of channel heads. Field observations and a similarity between predicted and observed area-slope relations suggest that the location of channels heads on steep slopes may by controlled by subsurface flow-induced instability of the colluvial fill. Preliminary field observations also suggest that abrupt channel heads on gentle slopes are controlled by seepage erosion, whereas gradual channel head locations appear to be governed by saturation overland flow. Consideration of the geometric relationship between source areas and the first-order drainages that contain them results in an inverse relation between mean source-basin length and drainage density. (Author's abstract)
W90-00955

2F. Groundwater

LATERAL MOVEMENTS OF VADOSE WATER IN LAYERED SOILS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00005

U.S. GEOLOGICAL SURVEY PROGRAM ON TOXIC WASTE--GROUND-WATER CONTAMINATION: PROCEEDINGS OF THE SECOND TECHNICAL MEETING, CAPE COD, MASSACHUSETTS, OCTOBER 21-25, 1985.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00022

CLAY MINERALOGY OF SEDIMENTS ASSOCIATED WITH A PLUME OF CREOSOTE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2K.
W90-00023

GEOCHEMISTRY OF A SHALLOW AQUIFER CONTAMINATED WITH CREOSOTE PRODUCTS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00024

REEXAMINATION OF THE OCCURRENCE AND DISTRIBUTION OF CREOSOTE COMPOUNDS IN GROUND WATER.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W90-00025

HYDROGEOLOGIC CONTROLS ON SOLUTE TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Boston, MA.
For primary bibliographic entry see Field 5B.
W90-00028

DESIGN AND IMPLEMENTATION OF A LARGE-SCALE NATURAL-GRADIENT TRACER TEST.
Geological Survey, Boston, MA.
For primary bibliographic entry see Field 5B.
W90-00029

IDENTIFICATION OF TRACE ORGANIC SUBSTANCES IN SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W90-00030

FATE OF AMMONIUM IN A SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-00032

SURFICIAL AND SUBSURFACE DISTRIBUTION OF AQUIFER SEDIMENTS AT THE BEMIDJI, MINNESOTA, RESEARCH SITE.
State Univ. of New York Coll. at Plattsburgh.
D. A. Franzi.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C5-C10, 3 ref.

Descriptors: *Glacial aquifers, *Glacial sediments, *Sediment transport, *Aquifers, Minnesota, Permeability, Stratification, Diamictons, Outwash, Lithography, Moraines, Lake sediments, Hydraulic permeability, Distribution patterns.

The Bemidji research site lies within a pitted and dissected outwash plain that is bordered on the southwest by a low-relief till upland and on the north by an end moraine complex. The morainal sediments north of the site consist of complexly interbedded diamictons, gravels, and sands. The diamictons are massive to medium bedded, light olive brown, with sandy to silty texture. The lithofacies associations and the presence of flow structures within the sedimentary sequence indicate deposition in an ice-proximal, subaerial environment. Outwash sediments consist of moderately calcareous, moderately to poorly sorted sandy gravel, gravelly sand, and sand. The stratified diamicton and its associated lithofacies are separated from the overlying outwash sand and gravel by an unconformity that is marked by a discontinuous layer (0 to 5 m) of thinly bedded to laminated, gray, fine sand, silt, and clay. These sediments probably were deposited in local kettle lakes formed after the retreat of ice from the moraine position. Where the lacustrine sediments are absent, the unconformity may be marked by a thin oxidized horizon. Estimates of the intrinsic permeability of the aquifer sediments from granulometric analyses range from 0.5 m/sec to. 27 millimeter/sec for the stratified drift units to 0.002 m/sec to 9.9 nanometer/sec for the lacustrine sediments and diamictons. (See also W90-00022) (Lantz-PTT)
W90-00033

HYDROGEOLOGY AND PRELIMINARY REGIONAL FLOW MODELING AT THE BEMIDJI, MINNESOTA, RESEARCH SITE.
Geological Survey, St. Paul, MN.
R. T. Miller.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C11-C16, 5 fig.

Descriptors: *Geohydrology, *Groundwater movement, *Hydraulic models, *Path of pollutants, *Minnesota, Bemidji, Hydraulic permeability, Flow velocity, Organic carbon, Oil pollution, Outwash, Simulation, Plumes, Water table wells, Piezometers, Finite difference methods.

The Bemidji research site is located on an outwash plain, that is pitted and dissected regionally by gravel-filled channels that are now partly occupied by kettle lakes. Approximately 35 water table wells and 10 piezometer nests have been installed to determine the direction and velocity of groundwater flow through the site. A steady-state approximation of regional groundwater flow indicates that flow generally is northeastward through the site toward an unnamed lake. The horizontal hydraulic gradient from 0.002 to 0.003. Two finite difference groundwater flow models were constructed to simulate the flow system at the site. One is a fully three-dimensional model, the other is a two-dimensional vertical section flow model that corresponds to the 11th row of the three-dimensional model. The components of groundwater velocity that were computed by the model were examined in a scaled-mass fraction contaminant transport simulation of a 6-yr period using the steady-state water level configuration. Three-dimensional model results indicate that the general shape of the contaminant plume is similar to that delineated from dissolved organic carbon data collected August 20, 1985. The model also indicates that a low concentration of contaminant has probably reached the unnamed lake. The two-dimensional cross-section model suggests that contaminants have the potential to reach a depth of 4 ft below the water table. Although both simulations assume the viscosity and density of the oil residuals to be equal to those of the ambient groundwater, and do not simulate the decay or chemical/biological changes in the oil residuals, the models indicate that the predicted groundwater velocities are reasonable for the simulated area. (See also W90-00022) (Lantz-PTT)
W90-00034

INORGANIC GEOCHEMISTRY OF GROUND WATER AND AQUIFER MATRIX: FIRST-YEAR RESULTS.
Syracuse Univ., NY.
For primary bibliographic entry see Field 5C.
W90-00035

GEOHYDROLOGIC SETTING OF THE MIAMI WASH-PINAL CREEK ACIDIC GROUND-WATER STUDY AREA NEAR GLOBE, ARIZONA.
Geological Survey, Tucson, AZ.
J. H. Eychaner.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p E3-E5, 1 fig, 2 ref.

Descriptors: *Acidic water, *Acid mine drainage, *Geohydrology, *Groundwater quality, *Groundwater movement, Arizona, Sulfates, Hydrogen ion concentration, Geochemistry, Metals, Manganese, Copper, Iron, Runoff, Alluvial aquifers, Ephemeral streams, Perennial streams, Model studies, Acidic water, Surface-groundwater relations, Groundwater recharge.

Water that contains elevated concentrations of dissolved metals and sulfate at pH 3.6 is moving through a shallow alluvial aquifer and interacting with surface streams near Globe, AZ. The water has contaminated public water supplies, and discharge from the aquifer to a stream has the potential to degrade public supplies for Phoenix, AZ, 130 km west of the study area. Objectives of a study begun in May 1984, are to describe the physical and chemical characteristics of the system, to estimate the chemistry of future stream outflow, and to evaluate models of the transport of reactive constituents in groundwater. About 0.3 cu m/sec of water flows through the aquifer and forms a perennial stream at its downstream boundary. Dissolved solids concentration at the outflow has increased about 70 mg/L annually since 1979 and reached 3,000 mg/L in 1984. Dissolved Mn increased from 0.5 mg/L in 1979 to 15 mg/L in 1985. Groundwater samples in the upstream part of the area contains as much as 16,000 mg/L dissolved solids, including 10,400 mg/L sulfate, 3,200 mg/L Fe, 150 mg/L Cu, and 73 mg/L Mn. As the acidic water reacts with calcite and other minerals in the aquifer, pH rises, and many metals become less soluble. This neutralization can continue until the calcite supply in the affected flow tube is exhausted. Where acidic water reaches the surface, ferric hydroxide precipitates and probably adsorbs other metals. Intermittent runoff in the sand channels of Miami Wash and Pinal Creek can transport the precipitate out of the study area. Manganese oxide precipitates have been found in the perennial-flow reach of Pinal Creek. Streamflow in the upstream part of the area is generally ephemeral; two reaches contain interrupted flow. For the first 6 months of 1985, however, streamflow was continuous through the valley, and outflow was about 1.1 cu m/sec. Recharge to the aquifer during this period raised water levels in wells by as much as 3.5 m, and some levels rose to 1 m below land surface. (See also W90-00022) (Lantz-PTT)
W90-00042

NEUTRALIZATION OF ACIDIC GROUND WATER IN EASTERN ARIZONA.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-00043

ARSENIC IN AN ALLUVIAL-LACUSTRINE AQUIFER, CARSON DESERT, WESTERN NEVADA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2K.
W90-00045

SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN GROUND WATER BY GAS CHROMATOGRAPHY WITH PHOTOIONIZATION AND HALL DETECTORS.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5A.
W90-00049

PROGRAM OVERVIEW AND SELECTED PAPERS FROM THE TOXIC-WASTE PROGRAM TECHNICAL MEETING: TUCSON, ARIZONA, MARCH 20-22, 1984.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00052

OVERVIEW OF ORGANIC COMPOUNDS IN GROUND WATER.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00054

CAPACITIES AND MECHANISMS OF SORPTION OF ORGANIC COMPOUNDS BY WATER-SATURATED AND UNSATURATED SOILS.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00056

MICROBIAL POPULATIONS AND NUTRIENT CONCENTRATIONS IN A JET-FUEL-CONTAMINATED SHALLOW AQUIFER AT TUSTIN, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W90-00059

ADSORPTION AND DESORPTION OF HEXAVALENT CHROMIUM IN AN ALLUVIAL AQUIFER NEAR TELLURIDE, COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00060

EPA: GROUND WATER HANDBOOK.
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W90-00087

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME I.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5A.
W90-00132

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME II.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 7C.
W90-00133

RESOURCE DOCUMENT: FOR THE CONSIDERATION OF THE TULALIP AQUIFER AS A SOLE SOURCE AQUIFER.
Environmental Protection Agency, Seattle, WA. Office of Ground Water.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-115216. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA 910/9-88-188, April 1988. 20p, 3 fig, 3 tab, 19 ref, 2 append.

Descriptors: *Water policy, *Washington, *Groundwater quality, *Water supply, *Aquifers, *Groundwater management, *Tulalip Aquifer, Groundwater movement, Potable water, Drinking water.

The proposed Tulalip Sole Source Aquifer area is located in northwest Snohomish County, Washington and covers approximately 180 sq mi. The area originally petitioned by the Seven Lakes Water Association Inc. has been expanded to include the entire aquifer area. The aquifer is composed of mostly unconsolidated glacial deposits overlying consolidated sandstone, metamorphic, and igneous bedrock units. Groundwater flows generally from east to west, with local systems present in topographically high areas. To qualify as a sole source aquifer, an aquifer must supply at least 50% of the area's drinking water, and there must be no economically feasible alternative sources that can substitute for the total drinking water supplied by the aquifer. An analysis of available data indicates that the proposed area meets these criteria and qualifies for designation as a sole source aquifer area. Approximately 99.7% of drinking water in the area comes from the aquifer, compared to 0.3% from surface water sources. There are also no economically feasible alternative drinking water sources to supply the area should the aquifer become contaminated. Potential surface water sources are considered to be too costly when treatment, transportation, and fisheries habitat losses are considered, and deepening or drilling additional wells provides no assurance that uncontaminated water would be obtained because of the nature of the aquifer materials. Designation of the area as a sole source aquifer would establish a process whereby EPA would review federal financially assisted projects proposed in the area. These reviews would be conducted by EPA to assure that proper design, construction, and operational controls are in place to protect the aquifer from contamination that may cause a significant adverse effect on the public health. (Lantz-PTT)
W90-00144

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W90-00153

GROUNDWATER PUMPING TESTS: DESIGN AND ANALYSIS.
W. C. Walton.
Lewis Publishers, Chelsea, MI. 1987. 201p.

Descriptors: *Computer programs, *Path of pollutants, *Groundwater management, *Pumping tests, *Computer models, Design standards, Groundwater movement, Groundwater budget, Partially penetrating wells, Boundary conditions, Transmissivity, Tidal hydraulics, Performance evaluation, Storage capacity, Water table decline, Aquitards.

During the last two decades, great progress has been made in computer modeling of groundwater flow and contaminant transport problems. The reliability of model results largely rests on knowledge of the hydraulic characteristics of aquifer systems. A pumping test is one of the most suitable means of quantifying hydraulic characteristics because it yields results which, in general, are representative of a larger area than are results from single point observations. In this book, pumping test techniques are modified, supplemented, and integrated with microcomputer programs to facilitate improved pumping test design and analysis. Type-curve matching techniques are emphasized. Methods for analyzing the response of an aquifer to an instantaneous charge of water, and the head variation due to depressurization are not covered. This book restricts itself to pumping tests in uniformly porous aquifer systems such as granular deposits. Other important aquifer system and facility conditions which may influence pumping test data and are covered in this book include: (1) production well discharge partly derived from water stored within the well (well storage capacity); (2) partially penetrating wells with aquifer stratification; (3) water table decline with delayed gravity yield; (4) nearby aquifer system boundaries or discontinuities; (5) aquitard storativity and source bed drawdown; (6) decreased transmissivity with water table decline; (7) interference from nearby production well; (8) changes in barometric pressure or stream stages; and (9) tidal fluctuations. (Lantz-PTT)
W90-00159

ANALYTICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
W. C. Walton.
Lewis Publishers, Chelsea, MI. 1989. 173p.

Descriptors: *Groundwater movement, *Path of pollutants, *Computer programs, Computer models, Model studies, Aquifers, Artesian wells, Injection wells, Water pollution sources.

Four analytical microcomputer programs for quick and easy simulation and graphing of uncomplicated two-dimensional groundwater flow and contaminant migration situations are presented in this book. Their operation is explained, and program concepts, techniques, and methods are described. The BASIC programs feature approximate simulations of the following aquifer, sink, and source conditions: non-leaky artesian, leaky artesian,

water table, barrier and recharge boundaries and discontinuities; production and injection wells, drains, and mines; and contaminant slug and continuous source areas and plumes, respectively. Medium quality screen graphic subprograms interpolate surface data and display drawdown and contaminant concentration arithmetic and semilog temporal graphs and spacial contour contour maps. Program simplicity makes the program listings easy to follow and to alter. The programs WELFUN, WELFLO, CONMIG, and GWGRAF are tailored to the IBM PC and compatible microcomputers. (See also W90-00174) (Lantz-PTT)
W90-00162

NUMERICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
W. C. Walton.
Lewis Publishers, Chelsea, MI. 1989. 272p.

Descriptors: *Numerical analysis, *Groundwater movement, *Computer models, *Simulation analysis, *Path of pollutants, Mathematical models, Aquifer systems, Solute transport, Computer programs.

Two microcomputer programs for simulating quasi-three-dimensional groundwater flow and contaminant migration are presented in this book. The numerical and analytical techniques incorporated in these programs are described. The two programs GWFL3D and GWTR3D are extensive modifications and extensions of, and sequels to, the popular public domain mainframe computer programs PLASM and RANDOM WALK. GWFL3D and GWTR3D are tailored to the IBM PC and compatible microcomputers. Aquifer systems conditions are user-defined by entering an appropriate number designated for desired options in response to prompt message lines. Input/output options include: database hard copies produced by a printer and database diskette files; spacial and temporal numerical water level and concentration diskette files, screen displays, and hard copies. (See also W90-00162) (Lantz-PTT)
W90-00174

CALCULATIONS OF DISPERSION PROCESSES IN GROUNDWATER BY THE METHOD OF FINITE ELEMENTS (BERECHNUNG VON AUSBREITUNGSVORGAENGEN IM GRUNDWASSER MIT DER METHODE DER FINITEN ELEMENTE).
Karlsruhe Univ. (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
For primary bibliographic entry see Field 5B.
W90-00187

GEOHYDROLOGY AND MODEL ANALYSIS OF STREAM-AQUIFER SYSTEM ALONG THE ARKANSAS RIVER IN KEARNY AND FINNEY COUNTIES, SOUTHWESTERN KANSAS.
L. E. Dunlap, R. J. Lindgren, and C. G. Sauer.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2253, 1985. 52p, 38 fig, 3 tab, 23 ref.

Descriptors: *Geohydrology, *Hydrologic models, *Arkansas River, *Kansas, *Surface-groundwater relations, Groundwater level, Computer models, Aquifers, Simulation analysis, Groundwater mining, Groundwater recharge.

A study was conducted to determine geohydrologic conditions in an area comprising nearly 850,000 acres along the Arkansas River valley in southwestern Kansas. Declines in static water levels in wells in the heavily pumped lower aquifer ranged from 20 to 80 ft during 1974-1980. The river is dry in much of the area. A digital computer model was calibrated to simulate the trends of historic water levels. Simulated average annual recharge to the unconsolidated aquifer system was 531,700 acre-ft less than average annual discharge, indicating the groundwater resource is currently (1982) being mined in the study area. Simulation also indicated that there would be sufficient saturated thickness in 2005 for irrigation if 1980 hydrologic conditions continued. Seepage losses from the Arkansas River and irrigation canals are a major source of recharge to the unconsolidated aquifer system. Streamflow seepage losses could be decreased by (1) decreasing the number of wells pumping in the study area in order to reduce downward leakage from the valley aquifer, or (2) increasing streamflow discharge in order to recharge the valley aquifer. As long as river stage remains high, the water table in the valley aquifer continues to rise. Seepage from the river to the valley aquifer decreases as the altitude difference between the river stage and the valley aquifer decreases. However, a rise in the water table in the valley aquifer because of recharge from the river will correspond to increased downward leakage to the lower aquifer, impeding recharge to the valley aquifer. (Lantz-PTT)
W90-00196

GEOHYDROLOGY AND WATER RESOURCES OF THE PAPAGO FARMS-GREAT PLAIN AREA, PAPAGO INDIAN RESERVATION, ARIZONA, AND THE UPPER RIO SONOYTA AREA, SONORA, MEXICO.
Geological Survey, Sacramento, CA.
K. J. Hollett.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2258, 1985. 44p, 21 fig, 4 tab, 46 ref.

Descriptors: *Water resources, *Groundwater depletion, *Geohydrology, *Groundwater budget, *Arizona, Aquifers, Groundwater reservoirs, Transmissivity, Wells, Groundwater quality, Simulation analysis, Groundwater irrigation, Water storage, Groundwater level, Irrigation, Water quality.

The Papago Farms-Great Plain and upper Rio Sonoyta study area includes about 490 sq mi in south-central Arizona and north-central Sonora, Mexico. Nearly all the water used to irrigate more than 5,000 cultivated acres in the study area is withdrawn from the unconsolidated to partly consolidated basin fill. The groundwater occurs in the deposits under unconfined (water table) conditions with a saturated thickness that ranges from zero to > 8,000 ft. The amount of recoverable groundwater in storage to a depth of 400 ft below the 1978-80 water table is estimated to be about 10 million acre-ft. Transmissivities along the basin margins range from 10,000 to 40,000 sq ft/day, while transmissivities in the basin center lakebed clay deposits are < 100 sq ft/day. Most wells that are located along the basin margin and tap more than 300 feet of saturated basin fill in the upper 1,000 feet of the aquifer, should yield from 500 to 3,000 gallons/minute (gpm) to properly constructed and developed wells. The water in the aquifer is moderate to poor in chemical quality for irrigation and public supply use. The groundwater is mainly a sodium bicarbonate type. The poorest quality water is associated with the basin center lakebed clay deposits. In 1981 outflow resulting from withdrawals of water was about 23,700 acre-ft. Storage is being depleted at a rate of about 19,000 acre-ft/yr. On the basis of a mathematical simulation of the groundwater system and withdrawal rates in 1981, water level declines in 1991 were estimated to be as much as 20 feet at Papago Farms and more than 40 feet in the area south of the basin center lakebed clay deposits. The estimated amount of depletion in 1991 of groundwater stored in the upper 400 feet of the aquifer is < 3.0% of the total amount in storage. (Lantz-PTT)
W90-00198

SUBSURFACE STORAGE OF FRESHWATER IN SOUTH FLORIDA: A DIGITAL MODEL ANALYSIS OF RECOVERABILITY.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W90-00200

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W90-00201

QUALITY OF GROUND WATER IN IDAHO.
Geological Survey, Honolulu, HI. Water Resources Div.
J. J. S. Yee, and W. R. Souza.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2272, 1987. 53p, 21 fig, 2 tab, 17 ref.

Descriptors: *Water resources data, *Data collections, *Geochemistry, *Water quality, *Groundwater quality, *Idaho, Aquifers, Hydrology, Fluorides, Cadmium, Iron, Drinking water, Potable water.

The major aquifers in Idaho are categorized under two rock types, sedimentary and volcanic, and are grouped into six hydrologic basins. Wide variations in chemical concentrations in the water occur within individual aquifers, as well as among the aquifers. The existing data base is not sufficient to describe fully the groundwater quality throughout the State; however, it does indicate that the water is generally suitable for most uses. In some aquifers, concentrations of fluoride, cadmium, and iron in the water exceed the EPA drinking water standards. Dissolved solids, chloride, and sulfate may cause problems in some local areas. Primary concerns related to special problem areas in Idaho include: (1) protection of water quality in the Rathdrum Prairie aquifer, (2) potential degradation of water quality in the Boise-Nampa area, (3) effects of widespread use of drain wells overlying the eastern Snake River Plain basalt aquifer, and (4) disposal of low level radioactive wastes at the Idaho National Engineering Laboratory. Shortcomings in the groundwater quality data base are categorized as: (1) multi-aquifer sample inadequacy, (2) constituent coverage limitations, (3) baseline-data deficiencies, and (4) data base nonuniformity. (Lantz-PTT)
W90-00202

ARTESIAN PRESSURES AND WATER QUALITY IN PALEOZOIC AQUIFERS IN THE TEN SLEEP AREA OF THE BIGHORN BASIN, NORTH-CENTRAL WYOMING.
M. E. Cooley.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2289, 1986. 54p, 13 fig, 9 tab, 5 plates, 21 ref.

Descriptors: *Artesian pressure, *Wyoming, *Madison-Bighorn Aquifer, *Groundwater quality, *Aquifers, Wyoming, Groundwater movement, Transmissivity, Hydrologic properties, Wells, Sodium, Salinity, Dissolved solids.

The major Paleozoic artesian aquifers in the Ten Sleep area of the Bighorn Basin of Wyoming are the Tensleep Sandstone, the Madison Limestone and Bighorn Dolomite, and the Flathead Sandstone. The minor aquifers include the Goose Egg and Park City Formations. Most wells completed in the major and minor aquifers flow at the land surface. Flowing wells completed in the Madison-Bighorn aquifer and the Flathead Sandstone yield > 1,000 gallons/minute (gpm). The initial test of one well completed in the Madison-Bighorn aquifer indicated a flow rate of 14,000 gpm. Transmissivities range from 500 to 1,900 sq ft/day for the Madison-Bighorn aquifer and from about 90 to 325 sq ft/day for the Tensleep and Flathead Sandstones. Water moves upward from the Tensleep and other formations, through the Goose Egg Formation, to discharge at the land surface as springs. Much of the spring flow is diverted for irrigation or is used for rearing fish. Decreases from original well pressures were not apparent in wells completed in the Tensleep Sandstone or in the Madison-Bighorn aquifer. Most wells completed in the Flathead Sandstone, which also are open to the Madison-Bighorn aquifer, show a decrease of pressure from the time of completion to 1978. Well water

from the Paleozoic aquifers generally contains minimal concentrations of dissolved solids and individual constituents but excessive hardness. The water has low sodium (alkali) and medium salinity; therefore, the water is satisfactory for irrigation and most other uses, if excessive hardness is not a detrimental factor. (Lantz-PTT)
W90-00206

ESTIMATION OF RECHARGE RATES TO THE SAND AND GRAVEL AQUIFER USING ENVIRONMENTAL TRITIUM, NANTUCKET ISLAND, MASSACHUSETTS.
J. F. Knott, and J. C. Olimpio.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2297, 1986. 26p, 13 fig, 5 tab, 40 ref.

Descriptors: *Tracers, *Recharge, *Groundwater recharge, *Aquifers, *Tritium, *Nantucket, Massachusetts, Groundwater movement, Groundwater budget, Flow rates, Porosity, Statistical methods.

Estimation of the average annual rate of groundwater recharge to sand and gravel aquifers using elevated tritium concentrations in groundwater is an alternative to traditional steady-state and water balance recharge rate methods. The Nantucket tritium recharge rates clearly are higher than rates determined elsewhere in southeastern Massachusetts using the tritium, water table fluctuation, and water balance methods, regardless of the method or the area. Because the recharge potential on Nantucket is so high (runoff is only 2% of the total water balance), the tritium recharge rates probably represent the effective upper limit for groundwater recharge in this region. The accuracy of the tritium method is dependent on two factors: the accuracy of the effective porosity data, and the sampling interval. For some sites, the need for recharge rate data may require a determination as statistically accurate as that which can be provided by the tritium method. However, the tritium method is more costly and more time consuming than the other methods. For many sites, a less accurate, less expensive, and faster method of recharge rate determination might be more satisfactory. (Author's abstract)
W90-00210

METHODS AND COMPUTER PROGRAM DOCUMENTATION FOR DETERMINING ANISOTROPIC TRANSMISSIVITY TENSOR COMPONENTS OF TWO-DIMENSIONAL GROUND-WATER FLOW.
Geological Survey, Doraville, GA.
M. L. Maslia, and R. B. Randolph.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2308, 1987. 46p, 8 fig, 2 tab, 19 ref, 5 append.

Descriptors: *Groundwater movement, *Computer programs, *Transmissivity, *Anisotropy, Hydraulic models, Hydraulic properties, Aquifers, Geohydrology, Statistical methods, Observation wells.

This report describes the theory of anisotropic aquifer hydraulic properties and a computer program, written in Fortran 77, for computing the components of the anisotropic transmissivity tensor of two-dimensional groundwater flow. To determine the tensor components using one pumping well and three observation wells, the type-curve and straight-line approximation methods are described. These methods are based on the equation of drawdown developed for two-dimensional nonsteady flow in an infinite anisotropic aquifer. To determine tensor components using more than three observation wells, a weighted least-squares optimization procedure for use with the type-curve and straight-line approximation methods is described. The computer program described in this report allows the type-curve, straight line approximation, and weighted least-squares optimization methods to be used in conjunction with data from observation and pumping wells. Three example applications are provided using the computer program and field data gathered during geohydrologic investigations at a site near Dawsonville, Ga. For the type-curve method, data from three observation wells are used; for the weighted least-squares optimization method, eight observation wells and equal weighting; and for the weighted least-squared optimization method, eight observation wells and unequal weighting. Results obtained by means of the computer program indicate major transmissivity (T sub M) in the range of 381 to 296 sq ft/day, minor transmissivity (T sub M) in the range of 139 to 99 sq ft/day, aquifer anisotropy (T sub M/T sub M) in the range of 3.54 to 2.14, principal direction of flow in the range of N 45.9 degree E to N 58.7 degree E, and storage coefficient in the range of 0.0063 to 0.0037. The numerical results are in good agreement with field data gathered on the weathered crystalline rocks underlying the investigation site. Supplemental material provides definitions of variables, data requirements and corresponding formats, input data and output results for the example applications, and a listing of the Fortran 77 Computer code. (Author's abstract)
W90-00215

QUANTITATIVE ASSESSMENT OF THE SHALLOW GROUND-WATER FLOW SYSTEM ASSOCIATED WITH CONNETQUOT BROOK, LONG ISLAND, NEW YORK.
K. R. Prince, O. L. Franke, and T. E. Reilly.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2309, 1988. 28p, 14 fig, 6 tab, 17 ref.

Descriptors: *Groundwater movement, *Quantitative analysis, *Flow profiles, *New York, *Surface-groundwater relations, Model studies, Hydraulic conductivity, Hydraulic models, Sensitivity analysis.

The movement of shallow groundwater was studied during 1975-82 at Connetquot Brook, an undisturbed stream in Connetquot River State Park, in south-central Long Island, New York. Groundwater flows essentially horizontally throughout the drainage basin except near and beneath the stream, where it moves vertically upward toward the stream discharge boundary. Water levels in wells driven directly into the streambed and into the streambank at three sites were 1 to 2 feet higher than stream stage in the first 5 feet of penetration. Increases in head, which were detected to depths of 30 feet beneath the streambed, indicate upward movement of water above that depth. Hydraulic conductivity values were between 11 and 15 ft/day. Dissolved oxygen showed no pattern, but tritium concentrations about 1,000 feet from the stream were lower than those near the stream. The tritium concentrations indicate that the lower flow boundary was between 45 and 100 feet below the water table. A two-dimensional cross sectional flow model of the shallow flow system was developed. The near-stream model response compared well with field data when the streambed discharge boundary was simulated as a uniform leaky bed. Sensitivity analysis results indicate that: (1) streambed factors (width and hydraulic conductivity) are most influential upon heads near the stream, (2) factors representing thickness of the shallow flow system influence heads distant from the stream but have a negligible effect near the stream, and (3) factors that represent the quantity of water entering the system (recharge) influence the heads throughout the area. Field measurements of hydraulic head indicate that the thickness of the shallow flow system below the stream channel is about 30 feet. However, results of the sensitivity analysis indicate that the shallow system's thickness has a negligible effect on head distribution beneath the stream. (Lantz-PTT)
W90-00216

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA.
W. D. Nichols.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2312, 1987. 57p, 32 fig, 17 tab, 1 plate, 37 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Geohydrology, *Aeration zone, *Waste disposal, *Radioactive wastes, *Nevada, Soil water potential, Hydraulic conductivity, Percolation, Soil water, Groundwater movement.

Low-level radioactive solid waste has been buried in trenches at a site near Beatty, NV, since 1962. In 1976, as part of a national program, the U.S. Geological Survey began a study of the geohydrology of the waste burial site to provide a basis for estimating the potential for radionuclide migration in the unsaturated zone beneath the waste burial trenches. The waste burial facility is in the northern Amargosa Desert about 170 kilometers (km) northwest of Las Vegas, NV. Mean annual precipitation at Lathrop Wells, 30 km south of the site, is only 7.4 cm. The mean daily maximum temperature at Lathrop Wells in July, the hottest month, is 37 C. The site is underlain by poorly stratified deposits of gravelly or silty sand and sandy gravel, and thick beds of clayey sediments. The total thickness of valley-fill deposits beneath the site is about 175 m; the unsaturated zone is about 85 m thick. Volumetric soil moisture to depths of 4 m ranges from 4% to 10% but commonly is in the range of 6% to 8%. Soil water potential, measured to depths of 3 to 10 m, ranged from -10 to -70 bars. Unsaturated hydraulic conductivity computed from laboratory analyses of representative samples ranges from 10 to the 13th power to 0.001 cm/day. A numerical analysis (1) demonstrated that a potential exists for deep percolation (> 2 m), despite high annual evaporation demands, and (2) provided predictions of the time of year and the antecedent conditions that enhance the probability of deep percolation. Soil moisture profiles obtained monthly over an 18-month period demonstrate that deep percolation does occur. Calculation of downward moisture movement through the waste trench backfill material, on the basis of simplified assumptions, suggests that moisture could have penetrated as much as 6 m below land surface from 1963, when the oldest trenches were closed, to 1980, but that the moisture requirement for such penetration far exceeded the amount of moisture actually available. Steady-state downward movement of moisture at depths greater than 10 m and beneath the waste burial trenches would be on the order of 4 cu m/1,000 yr, assuming a steady flux rate of 0.1 microcentimeter/day. (Author's abstract)
W90-00218

EFFECTS OF BOUNDARY CONDITIONS ON THE STEADY-STATE RESPONSE OF THREE HYPOTHETICAL GROUND-WATER SYSTEMS--RESULTS AND IMPLICATIONS OF NUMERICAL EXPERIMENTS.
Geological Survey, Syosset, NY. Water Resources Div.
O. L. Franke, and T. E. Reilly.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2315, 1987. 19p, 2 fig, 6 tab, 4 ref, 2 append.

Descriptors: *Pumping, *Pumping testing, *Aquifer tests, *Boundary conditions, *Mathematical studies, *Groundwater movement, Groundwater depletion, Groundwater budget, Hydraulic conductivity, Hydrologic models.

The effects of different boundary conditions on the steady-state response of otherwise similar groundwater systems to a pumping stress are demonstrated. Three series of numerical experiments illustrate the behavior of three hypothetical groundwater systems that are rectangular sand prisms with the same dimensions but with different combinations of constant-head, specified-head, no-flow, and constant-flux boundary conditions. In the first series of numerical experiments, the heads and flows in all three systems are identical, as are the hydraulic conductivity and system geometry. However, when the systems are subjected to an equal stress by a pumping well in the third series, each differs significantly in its response. The highest heads (smallest drawdowns) and flows occur in the systems most constrained by constant-head or specified-head boundaries. These and other observations described are important in steady-state calibration,

which is an integral part of simulating many groundwater systems. Because the effects of boundary conditions on model response often become evident only when the system is stressed, a close match between the potential distribution in the model and that in the unstressed natural system does not guarantee that the model boundary conditions correctly represent those in the natural system. In conclusion, the boundary conditions that are selected for simulation of a groundwater system are fundamentally important to groundwater systems analysis and warrant continual reevaluation and modification as investigation proceeds and new information and understanding are acquired. (Author's abstract)
W90-00220

AQUEOUS GEOCHEMISTRY OF THE MAGOTHY AQUIFER, MARYLAND.
Geological Survey, Idaho Falls, ID.
For primary bibliographic entry see Field 2K.
W90-00223

GEOCHEMICAL EVOLUTION OF AQUEOUS SODIUM IN THE BLACK CREEK AQUIFER, HORRY AND GEORGETOWN COUNTIES, SOUTH CAROLINA.
For primary bibliographic entry see Field 2K.
W90-00224

WELL SYSTEM TO RECOVER USABLE WATER FROM A FRESHWATER-SALTWATER AQUIFER IN PUERTO RICO.
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 4B.
W90-00225

TRITIUM MIGRATION FROM A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR CHICAGO, ILLINOIS.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00226

CONSEQUENCES OF SPATIAL VARIABILITY IN AQUIFER PROPERTIES AND DATA LIMITATIONS FOR GROUNDWATER MODELLING PRACTICE.
International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. 272p.

Descriptors: *Groundwater budget, *Model studies, *Groundwater movement, *Aquifers, Mathematical models, Mathematical studies.

The output of a numerical model of flow and/or solute transport in a groundwater system will normally contain errors of unknown magnitude. These errors arise from several sources: (1) the extent to which actual physical and chemical processes are represented in the model; (2) errors in the values of system parameters (aquifer properties; system geometry; initial and boundary conditions; natural and anthropogenic stresses); and (3) numerical methods used to solve differential equations. This report focuses attention on the relationship between uncertainty of model output and that of all parameters of the system. The objective is to draw together existing understanding for the benefit of consultants and other practitioners who use groundwater models. This report is presented in two parts. Part A presents the authors' synthesis of existing knowledge on the topic, together with their new contributions which are designed to draw the material together into a practical totality. Some effects of data uncertainty and aquifer variability are illustrated, first using simple, analytic models and later with several common numerical models. The data requirements of numerical models are discussed together with common methods for obtaining these data and typical problems of measurement. The evaluation of model output results is discussed in detail, and finally methods are considered for setting up models in such as way that output uncertainty is minimized. Part B of this report is a selection of papers from those which were presented at the International Association for Hydrological Sciences Workshop on Spatial Variability, Vancouver, August 1987. These papers provide more detail on specific aspects of the problem and illustrate recent trends in coping with data limitations in groundwater models. (See W90-00228 thru W90-00232) (Lantz-PTT)
W90-00227

CONSEQUENCES OF SPATIAL VARIABILITY IN AQUIFER PROPERTIES AND DATA LIMITATIONS FOR GROUNDWATER MODELLING PRACTICE.
A. J. Peck, S. M. Gorelick, G. de Marsily, S. Foster, and V. S. Kovalevsky.
IN: Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice. International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. p 5-161, 37 fig, 3 tab, 312 ref.

Descriptors: *Groundwater movement, *Groundwater budget, *Hydrologic models, *Model studies, Mathematical studies, Monte Carlo method, Aquifers.

Groundwater models are used to provide predictions, to help in the estimation of aquifer properties, and as components of resource management models. The extent of data required to run typical groundwater flow and transport models is discussed. Common sources of these data and typical errors are presented. The kriging method for spatial interpolation is derived together with the rules for averaging values of a parameter over a chosen area such as an element or a zone in a model. It is easy to show how small errors in inputs affect the uncertainty of output for very simple models, with sensitivity analysis as the simplest method to estimate possible errors in model output. The relationship between output and input uncertainty can be included as part of a model when it is expressed in the form of stochastic partial differential equations. Methods for solving such equations are introduced and discussed. They include spectral, perturbation, and Monte Carlo methods. Several different methods for conducting a sensitivity study are discussed in detail, including the so-called bracketing study, and use of the adjoint method. First-order uncertainty analysis is introduced, and references are provided to uncertainty analysis in several applied studies. Objectives for the accuracy of model output should be established in relation to one or more particular applications of the data. A scheme is presented for the development of a model with acceptable uncertainty in the required output. The most direct method to reduce the uncertainty that model predictions inevitably contain, is to upgrade the quality and the coverage of the data base through additional field measurement prior to use of the model for predictive purposes. The aquifer model itself, used in an identification or evaluation mode, will be useful in assessing priorities for this process of data base improvement. (See also W90-00227) (Lantz-PTT)
W90-00228

EFFECT OF CONDITIONING TRANSPORT SIMULATIONS ON TRANSMISSIVITY, HEAD AND CONCENTRATION DATA.
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 5B.
W90-00229

CONCEPT OF PREDICTIVE PROBABILITY AND A SIMPLE TEST FOR GEOSTATISTICAL MODEL VALIDATION.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W90-00230

STOCHASTIC FINITE ELEMENT ANALYSIS OF GROUNDWATER FLOW USING THE FIRST-ORDER RELIABILITY METHOD.
Missouri Univ.-Rolla. Dept. of Geological Engineering.
J. D. Cawlfield, and N. Sitar.
IN: Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice. International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. p 191-216, 12 fig, 28 ref. NSF Grant CEE-8352147.

Descriptors: *Model studies, *Groundwater movement, *Stochastic analysis, *Finite element method, Mathematical studies, Hydraulic conductivity, Boundary conditions, Probabilistic process.

An approach for stochastic analysis of groundwater flow based on the first-order reliability method is presented. The method can fully utilize any level of probabilistic information from the minimum of second-moments to the complete full joint distribution. It is well suited for problems in which the statistical information is incomplete, as is common when considering groundwater flow. The results of a first-order reliability analysis include an estimate of the probability of exceeding a specified performance criteria and the sensitivity of the stochastic solution to changes in the uncertain variables and their moments. First-order reliability results from an analysis of one-dimensional flow with uncertain hydraulic conductivity compare well with results from a previously presented Monte Carlo analysis. This two-dimensional stochastic finite element model, the uncertain variables are the element hydraulic conductivities and the values of constant head or point flux boundary conditions. Example two-dimensional applications are presented for confined flow between two constant head boundaries. The effect of spatial correlation between element hydraulic conductivities on the probability estimate and the sensitivity information is investigated. (See also W90-00227) (Author's abstract)
W90-00231

INFLUENCE OF SPATIAL VARIABILITY OF AQUIFER AND RECHARGE PROPERTIES IN DETERMINING EFFECTIVE PARAMETER VALUES.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
J. J. Gomez-Hernandez, and S. M. Gorelick.
IN: Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice. International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. p 217-272, 31 fig, 2 tab, 48 ref. UNESCO-ICGW Project 2.4d.

Descriptors: *Groundwater recharge, *Aquifers, *Mathematical analysis, *Model studies,*Hydraulic properties, Hydraulic conductivity, Spatial variation, Leakage, Mathematical studies, Groundwater movement.

A stochastic approach has been used to study the effects of spatial variability of aquifer characteristics on defining effective (uniform) aquifer model parameters. The parameters considered were hydraulic conductivity, river bed leakance, and aerially distributed recharge. An unconfined aquifer model was constructed for an area similar to that near Livermore, CA. Monte Carlo realizations of the parameters were generated for different spatial correlation structures. Parameters were considered to have a support scale equivalent to that of the finite difference blocks, except for the case involving local-scale conditioning. For each of the Monte Carlo realizations, groundwater flow was simulated. Estimates of the mean (expected value) and standard deviation of hydraulic heads for all of the realizations were obtained. In all cases stationarity of the parameters was assumed and an exponential-type semivariogram was used. Several different cases were studied. For the cases that explored hydraulic conductivity, comparisons were made between simulations using the geometric mean and the spatially variable values. The most striking result was that the geometric mean of the hydraulic conductivity (a uniform value) did not produce the expected value of heads. Rather, an effective hydraulic conductivity value between the harmonic mean and the geometric mean led to the best match with the expected value of heads. Devi-

ations in simulated heads based upon the geometric mean hydraulic conductivity versus those based upon the spatially variable hydraulic conductivity realizations were greatest near the pumping wells. The standard deviations in heads from most of the various sets of flow simulations were over 5 meters at the wells and diminished to less than 1 meter in between the wells. The geometric mean produced heads at the wells that were consistently above the expected heads. (See also W90-00227) (Lantz-PTT)
W90-00232

TECHNICAL AND ECONOMIC DATA DEVELOPMENT CONCERNING THE LUST PROGRAM.
Eastern Research Group, Inc., Arlington, MA.
For primary bibliographic entry see Field 5G.
W90-00249

HYDRAULIC CALCULATIONS FOR FLOW UNDER DIKES ON CONSOLIDATED BEDS (UNTERGRUNDHYDRAULISCHE BERECHNUNGEN AN FLUSSDEICHEN AUF BINDIGEN DECKSCHICHTEN).
Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
G. Garbrecht, J. Schmidt, and J. Buss.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80064/GAR. Price codes: E07 in paper copy, A01 in microfiche. February 1987. 164p, 84 fig, 52 ref. English summary.

Descriptors: *Groundwater movement, *Dikes, Hydraulic profiles, Permeability, Erosion, Mathematical equations, Drainage.

If the ground profiles on low ground near rivers consist of consolidated and non-permeable beds above sand and gravel conducting the groundwater, then there will be flow beneath dikes erected on them. There is also a danger of suffusion, erosion and hydraulic groundwater bursts. A knowledge of the potential distribution is of decisive importance for the underground hydraulic measurement of dikes with flow underneath. A process of calculation was therefore developed, partly based on the finite element method for one, two and three-dimensional steady and non-steady state, saturated and unsaturated dike systems and for aids in measurements. The required measures for securing dikes and for drying the dike hinterland by wells, drainage and unloading ditches, bucket elevators and culverts are suitably and safely dimensioned in position and size. (Author's abstract)
W90-00257

LABORATORY AND SEMI-TECHNICAL FIELD EXPERIMENTS FOR CHARACTERIZING THE MOST IMPORTANT PROCESSES INFLUENCING THE SORPTION AND MOBILIZATION OF HEAVY METALS IN SAND-FILTER-COLUMNS (LABOREXPERIMENTE UND HALBTECHNISCHE GELAENDEVERSUCHE ZUR CHARAKTERISIERUNG DER WICHTIGSTEN PROZESSE, WELCHE DIE BINDUNG UND MOBILISIERUNG VON SPURENMETALLEN IN LANGS AMSANDFILTERN BEEINFLUSSEN).
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W90-00267

MODELLING OF LARGE-SCALE HEAT AND CONTAMINANT TRANSPORT IN GROUNDWATER: REPORT OF ACTIVITIES 1986/87 (MODELLERUNG DES GROSSRAEUMIGEN WAERMETRANSPORTS UND SCHADSTOFFTRANSPORTS IM GRUNDWASSER: TAETIGKEITSBERICHT 1986/87).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
K. Kobus.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-81385/GAR. Price codes: E15 in paper copy, A01 in microfiche. 1987. 242p, 82 fig, 8 tab, 60 ref. English summary.

Descriptors: *Path of pollutants, *Groundwater pollution, *Heat flow, *Aquifers, *Model studies, Chlorinated hydrocarbons, Nitrates, Tropics, Flow pattern, Flow characteristics.

The objective of investigation is to work out general lines for calculating the transport of heat and constituents in aquifers, test these on specific examples and employ them in drawing up concepts for the sanitation, management, and protection of aquifers. On the basis of the flow-mechanical, hydrological, physical, and chemical fundamentals of materials transport, a general model concept is developed, which must be compatible particularly with the type of nature data available, in order to be suitable for practical use. Within this framework, fully developed models are to be devised for the transport of heat, chlorinated hydrocarbons and nitrates. The theoretical, numerical, and experimental investigations needed for this have been continuously based on observations of nature for topical events. (Author' abstract)
W90-00269

NITRATE MOVEMENT TO GROUNDWATER IN THE SOUTHEASTERN COASTAL PLAIN.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W90-00329

NUMERICAL ANALYSIS OF LARGE DIAMETER WELLS WITH A SEEPAGE FACE.
Centre for Water Resources, Madras (India).
R. Sakthivadivel, and K. R. Rushton.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 43-55, March 30 1989. 7 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Numerical analysis, *Aquifers, *Deep seepage, *Groundwater movement, *Test wells, Pump wells, Simulation, Hydraulic conductivity, Hydrologic properties.

A methodology is outlined for estimating the aquifer parameters from pumping tests in large diameter wells taking into account the dynamic seepage face. Based on the experimental observations in large diameter wells, an empirical equation is devised that approximately describes the dynamic variation of the seepage face. A general expression for the seepage face, which is the difference between the well water level and the phreatic surface at the well face, is deduced from experimental observations. A numerical model is used to simulate both the pumping and recovery phases of the test. Both the drawdown in the pumped well and the flow from the aquifer to the well are used in matching the model and field results. Examples used show that if the seepage face is ignored in the analysis, the value of the hydraulic conductivity is underestimated. (Author's abstract)
W90-00354

ISOTOPE STUDIES OF PRECIPITATION AND GROUNDWATER IN THE SIERRA DE LAS CRUCES, MEXICO.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2B.
W90-00360

BEHAVIOR OF DISSOLVED URANIUM IN GROUNDWATERS OF THE MORRO DO FERRO THORIUM DEPOSIT, BRAZIL.
Universidade Estadual Paulista, Sao Paulo (Brazil). Dept. de Fisica.
D. M. Bonotto.
Journal of Hydrology JHYDA7, Vol 107, No. 1-4, p 155-168, March 30 1989. 6 fig, 2 tab, 35 ref.

Descriptors: *Tracers, *Uranium, *Path of pollutants, *Groundwater pollution, *Geohydrology, *Groundwater movement, *Brazil, Uranium radioisotopes, Sampling, Boreholes, Clays, Percolation, Soil porosity, Adsorption.

Hydrological studies of groundwaters have utilized uranium as an important aid in investigating several problems, such as determination of general groundwater circulation patterns. Groundwater samples were collected for several months in boreholes drilled at Morro do Ferro, a thorium and rare earth deposit located on the Pocos de Caldas Plateau, Brazil. The U content and 234U/238U activity ration were measured in the groundwater samples and in spoil samples of a borehole drilled in the ore body. Some possible mechanisms related to the mobilization of uranium are considered, including complexation with humic substances and adsorption of clays. Enhanced 234U/238U activity ratios are ultimately attributed to preferential etching of 234U. The dissolved uranium concentration showed variability related to the rainwater infiltration with the U content of groundwaters increasing during wet periods. The amount of uranium mobilized during rainwater infiltration showed an inverse correlation with the thickness of unsaturated silty clay. The experimental evidence favors the possibility of formation of soluble complexes of U and dissolved organic compounds. Some adsorption of U by clays during rainwater infiltration also may be occurring. (Friedmann-PTT)
W90-00361

GROUNDWATER CHEMISTRY AND CATION BUDGETS OF TROPICAL KARST OUTCROPS, PENINSULAR MALAYSIA: I. CALCIUM AND MAGNESIUM.
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W90-00362

NUMERICAL MODELING OF A MULTI-AQUIFER SYSTEM IN EASTERN SAUDI ARABIA.
Arriyadh Development Authority, Riyadh (Saudi Arabia).
M. Rasheeduddin, H. Yazicigil, and R. I. Al-Layla.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 193-222, March 30 1989. 12 fig, 7 tab, 11 ref.

Descriptors: *Model studies, *Numerical analysis, *Aquifers, *Saudi Arabia, *Geohydrology, *Groundwater movement, Hydraulic properties, Groundwater management, Management planning, Aquitards.

A numerical quasi-three-dimensional groundwater flow model was constructed for a multi-aquifer system in eastern Saudi Arabia to determine the hydraulic properties of the system and to evaluate the consequences of various development alternatives. The aquifers modeled were the Alat, the Khobar and the Umm Er Radhuma of Paleocene-Eocene age, which are hydraulically connected with intervening aquitards. Steady-state and transient model calibrations demonstrated considerable spatial variations in transmissivities of the aquifers and vertical leakances of the aquitards. The reliabilities of these parameters were checked through sensitivity analysis. The model results have confirmed the hydraulic interaction between the aquifers via intervening aquitards. The calibrated model was subsequently utilized to predict responses of the aquifers over a planning horizon of 14 yrs (1987-2000) under three development alternatives. The model results indicated that the Khobar aquifer has a limited productivity in the Abqaiq region where dewatering is expected to occur if the existing trends in extraction rates are continued. The Umm Er Radhuma aquifer, however, has demonstrated relatively low declines in water levels, indicating very high potential for productivity. Freezing the current extraction rates throughout the planning period showed little change from the present conditions. Gradual introduction of conservation measures would be more effective in ensuring the long-term productivity of the aquifers. (Author's abstract)
W90-00363

ANALYSIS OF THE SHALLOW GROUNDWATER FLOW SYSTEM NEAR CONNETQUOT BROOK, LONG ISLAND, NEW YORK.
Geological Survey, Menlo Park, CA.
K. R. Prince, T. W. Reilly, and O. L. Franke.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4,

p 223-250, March 30 1989. 12 fig, 3 tab, 18 ref.

Descriptors: *Surface-groundwater relations, *New York, *Groundwater movement, *Long Island, *Aquifers, *Groundwater level, *Geohydrology, Water table, Hydraulic conductivity, Water analysis, Isotope studies.

Streamflow on Long Island is derived principally from shallow groundwater that flows above the deeper regional flow system. The movement of shallow groundwater was studied during 1975-82 at Connetquot Brook, an undisturbed stream in Connetquot River State Park, in south-central Long Island. The investigation encompassed: (1) field studies of streamflow, groundwater levels, and age of water as indicated by tritium concentrations, and (2) numerical simulation of the shallow flow system to evaluate the hydraulic factors that influence groundwater flow near and beneath the stream. Analysis of water-level data indicates that groundwater flow is essentially horizontal throughout the drainage basin except near and beneath the stream, where it moves upward diagonally and discharges to the stream. Water levels in wells driven directly into the streambed and in wells driven into the streambank at three sites were 1-2 ft higher than stream stage in the first 5 ft of penetration. Increases in head, which were detected to depths of 30 ft beneath the streambed, indicate upward movement of water above that depth. Water samples from selected wells were analyzed for tritium concentration to determine the relative age of water to locate the bottom boundary of the shallow flow system. Tritium concentrations indicate that the lower boundary is from 45 to 100 ft below the water table. A two-dimensional cross-sectional flow model of the shallow flow system indicated that: (1) stream width and streambed hydraulic conductivity influence heads mostly within about 50 ft of the stream; (2) the thickness of the shallow flow system influences heads more distant from the stream but has a negligible effect near the stream; and (3) the quantity of water entering the system as recharge from precipitation influences the heads throughout the area. Field measurements of hydraulic head indicate the shallow flow system to extend to about 30 ft below the stream channel. Results of the sensitivity analysis indicate that the thickness of the shallow system has a negligible effect on head distribution beneath the stream. (Author's abstract)
W90-00364

CALIBRATION OF FREQUENCY-DOMAIN ELECTROMAGNETIC INDUCTION METERS AND THEIR POSSIBLE USE IN RECHARGE STUDIES.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 7B.
W90-00365

ENGINEERING SOLUTION TO THE NITRATE PROBLEM OF A BOREHOLE AT SWAFFHAM, NORFOLK, U.K.
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 5G.
W90-00366

ASSESSMENT OF GROUNDWATER POTENTIAL FOR CONJUNCTIVE WATER USE IN A LARGE IRRIGATION PROJECT IN INDIA.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
For primary bibliographic entry see Field 4B.
W90-00367

STOCHASTIC APPROACH OF THE HYDRODYNAMIC DISPERSION IN A FRACTURED MEDIUM: VARIABILITY OF THE DISPERSION COEFFICIENT (APPROCHE STOCHASTIQUE DE L'HYDRODISPERSION EN MILIEU FISSURE: VARIABILITE DU COEFFICIENT DE DISPERSION).
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
E. Carlier, and G. Porel.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 329-341, March 30 1989. 20 ref. English summary.

Descriptors: *Dispersion, *Path of pollutants, *Model studies, *Stochastic process, *Hydrodynamics, *Porous media, *Geologic fractures, *Geohydrology, *Groundwater movement, Mathematical equations, Diffusivity, Hydrologic properties.

The equations of hydrodynamic dispersion based upon the classical theory of mass transfer in porous media are not always applicable to migration in fractured media where the anisotropic characteristics involve a divergence between experimental and computed results. A dispersion coefficient is calculated for a medium consisting of fractures with apertures having an exponential distribution; equations of concentration have been worked out for convection on the one hand, and for dispersion in the fractures on the other. The results are compared with results relating to medium consisting of tubes whose cross-sectional areas also have an exponential distribution. (Author's abstract)
W90-00370

ANAEROBIC BIODEGRADATION OF NITROGEN-SUBSTITUTED AND SULFONATED BENZENE AQUIFER CONTAMINANTS.
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5B.
W90-00462

FIELD APPLICATION OF A FINITE-ELEMENT WATER-QUALITY MODEL TO A COAL SEAM WITH UCG BURNS.
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5B.
W90-00577

REVERSE WATER LEVEL FLUCTUATIONS IN SEMICONFINED AQUIFER SYSTEMS--'RHADE EFFECT'.
H. R. Langguth, and C. Treskatis.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 79-93, July 1989. 10 fig, 1 tab, 22 ref.

Descriptors: *Piezometers, *Aquifers, *Pumping tests, *Water level fluctuations, *West Germany, Rhade effect, Drawdown.

Pumping tests conducted in semiconfined aquifers near Dorsten, FRG were found to cause anomalous reverse water level fluctuations in observation wells tapping the overlying confining bed (aquitard) at different depths (multilevel piezometer). Whenever water is pumped from a well that is screened in the aquifer of the 'Halterner Sande', the piezometric surface in the aquitard ('Bottroper Mergel') rises. After the observed increase, the water level falls according to the drawdown of head within the pumped aquifer. Conversely, the piezometric surface in the aquitard falls whenever the pump is shut off (Rhade effect). The anomalous water level reactions propagate with decreasing amplitude from the aquifer-aquitard boundary to the top of the semipermeable layer. These water level fluctuations ('swelling effects') may be explained by the capability of a water-saturated, compacted granular material to change volume when subjected to sudden pressure changes. On a practical basis, the Noordbergum and Rhade effects must be taken into consideration when evaluating long-term changes in chemical and hydraulic properties in pumped, semiconfined aquifer systems. (Author's abstract)
W90-00579

NONLINEAR EQUATION FOR GROUNDWATER ENTRY INTO WELL SCREENS.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. R. Singh, and S. K. Shakya.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 95-114, July 1989. 7 fig, 3 tab, 18 ref.

Descriptors: *Groundwater movement, *Well screens, *Well hydraulics, *Aquifers, Mathematical equations, Differential equations.

A nonlinear equation for the entry of water through the perforations in well screens is proposed along with a new parameter, screen hydraulic conductivity, K sub s. The experimental values of the experimentally determined exponent n vary randomly and follow a log-normal distribution with the mean of 1.911. The n=2 in a previously determined equation, which lies within a 95% confidence interval, used for computing well loss, is derived from the aforesaid flux law. Experimental results show the dependence of K sub s on the hydraulic conductivity of aquifer around the bore, K sub a, and the fractional open area in well screens. A relationship between K sub s and K sub a would be the characteristic of a screen and hence could form a basis for well screen testing. The results also show a failure of the orifice flow hypothesis in describing water entry through the slots of well screens. A problem of steady groundwater flow through a confined aquifer is formulated using the usual differential equation and a nonlinear (gradient and head) boundary condition incorporating the proposed flux law at the aquifer-screen interface. The semi-analytical solution yields the drawdown distribution in the aquifer. It is useful in computing yields from a screened well for different water levels in the well. (Author's abstract)
W90-00580

RELATIONSHIPS BETWEEN THE UNSATURATED ELECTRIC AND SATURATED HYDRAULIC PROPERTIES OF SOILS.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W90-00581

RELATION OF SALINITY AND SELENIUM IN SHALLOW GROUNDWATER TO HYDROLOGIC AND GEOCHEMICAL PROCESSES, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA.
Geological Survey, Sacramento, CA.
S. J. Deverel, and S. K. Gallanthine.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 125-149, July 1989. 13 fig, 1 tab, 39 ref.

Descriptors: *California, *San Joaquin Valley, *Groundwater pollution, *Alluvial fans, *Selenium, Salinity, Irrigation, Ephemeral streams.

Salinity and selenium concentrations in shallow groundwater of the western San Joaquin Valley, California, are related to the geomorphology and hydrology of the alluvial fans. The highest salinity and selenium concentrations in shallow groundwater occur in alluvium deposited by ephemeral streams and at the margins of the major alluvial fans, where there were naturally saline, fine-grained soils. Low-to-moderate salinity and selenium concentrations in shallow groundwater are associated with upper and middle areas of the major alluvial fans deposited by intermittent streams. Areas with the most naturally saline soils have been irrigated in the last 40 years. These are now the areas of highest salinity and selenium concentrations in the shallow groundwater. Present-day (1986) groundwater salinity is spatially correlated with natural soil salinity in these areas. Isotopic data indicate that the highest salinity and selenium concentrations in groundwater present at low altitudes resulted from evaporative concentration when the water table was shallow. (Author's abstract)
W90-00582

DISTRIBUTION OF GROUNDWATER SEEPAGE TO LARGE SURFACE-WATER BODIES: THE EFFECT OF HYDRAULIC HETEROGENEITIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
D. S. Cherkauer, and D. C. Nader.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 151-165, July 1989. 5 fig, 3 tab, 28 ref. Federal

grant NA84AA-D-00065.

Descriptors: *Surface-groundwater relations, *Groundwater, *Groundwater movement, *Seepage, *Great Lakes, Offshore seepage, Geohydrology, Sediment thickness, Bedrock conductivity, Lake size.

At 26 sites on the upper Great Lakes and their connecting channels where groundwater seepage measurements have been made, seepages decrease continually offshore at only seven (26%) sites. At 17 sites (63%) offshore seepages substantially exceed those at some locations closer to shore. The distributions fall into two consistent patterns, one where a nearshore decrease in seepage with increasing distance is succeeded offshore by an increase and a second where nearshore seepages are relatively constant and then increase farther offshore. The patterns have been observed in two independent studies using two totally different seepage meter designs and emplacement methods and are attributed to hydrogeologic heterogeneities beneath the surface-water body. Detailed marine geophysical measurements at seven sites on Green Bay show that the anamalously high offshore seepages there are associated with local thinning of the relatively low hydraulic conductivity glacial sediments separating the Bay from the underlying aquifer, a fractured dolomite. At these locations, heterogeneity in sediment thickness is a stronger factor in causing seepage anomalies than is heterogeneity of either sediment or bedrock hydraulic conductivity. Insufficient information exists to confirm a parallel cause-effect relation at the other sites, but evidence points in that direction. Similar seepage anomalies have been observed at other, smaller lakes by other researchers, but never with this frequency. It is argued that the cause of the difference is the size of the Great Lakes. Seepage occurs and measurements have been made over much greater offshore distances than in smaller lakes, and the likelihood that heterogeneities will occur within the zone of measurement is also much greater. (Author's abstract)
W90-00583

GROUNDWATER INTERACTION WITH A KETTLE-HOLE LAKE: RELATION OF OBSERVATIONS TO DIGITAL SIMULATIONS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
D. S. Cherkauer, and J. P. Zager.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 167-184, July 1989. 8 fig, 19 ref.

Descriptors: *Model studies, *Surface-groundwater relations, *Groundwater movement, *Seepage, *Glacial lakes, *Wisconsin, *Simulation analysis, Shoreline seepage, Groundwater mounds.

Observations made on a small, fully penetrating, kettle hole lake are used to test predictions made using digital simulation about the exchange of water between lakes and groundwater systems. On the upgradient side of Lower Nashotah Lake, groundwater inseepage decreases exponentially away from the shore. Water exchange on the downgradient side is controlled by the presence and strength of a groundwater mound, but that mound and its effects are ephemeral. When the mound increases in strength, it generates a local groundwater flow cell beneath it which contains water of chemical composition distinct from deeper, regional groundwater. The growing mound also causes local inseepage of groundwater to the lake in an expanding zone along the downgradient shore. All of these phenomena occur as they have been predicted in published studies where digital simulation of relatively simple groundwater-lake systems has been carried out. The field observations thus confirm the validity of the simulation studies and their usefulness as a tool for understanding water exchanges in unmonitored systems. (Author's abstract)
W90-00584

CHEMICAL CHARACTERISTICS OF A PYRENEAN BROOK UNDERFLOW (SUR LES CARACTERISTIQUES CHIMIQUES DU SOUS-ECOULEMENT D'UN RUISSEAU DES PYRENEES).
Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain.
R. Rouch, M. Bakalowicz, A. Mangin, and D. D'Hulst.
Annales de Limnologie ANLIB3, Vol. 25, No. 1, p 3-16, 1989. 9 fig, 2 tab, 22 ref. English summary.

Descriptors: *Underflow, *Groundwater, *Geochemistry, *Surface flow, *Water chemistry, *France, Calcite, Carbonmates, Model studies.

The water chemistry of the ruisseau de Lachein underflow (Pyrenees) was studied on a 75 sq m area, at a 60 cm depth and during a hydrological cycle. The underflow and surface waters have closed chemical characteristics which evolve synchronously throughtout the year. Yet, this analogy does not involve a direct relation between these two waters, for the calco-carbonic parameters show that underflow and surface waters evolve independently with limited exchanges. In the study area, the underflow chemistry is characterized by its spatial heterogeneity. This heterogeneity is connected to the different physiographic units defined by the surface flows. A functional model is proposed showing the existing relationships at different scale levels. (Author's abstract)
W90-00598

QUALITY OF THE GROUND WATER AROUND THE LOWER REACHES OF THE MIYA RIVER.
National Research Inst. of Aquaculture, Mie (Japan).
M. Sugiyama, K. Fujii, H. Maeda, T. Maruyama, and H. Kumada.
Bulletin of National Research Institute of Aquaculture YKHKDU, No. 15, p 29-36, 1989. 2 fig, 1 tab, 15 ref. English summary.

Descriptors: *Aquaculture, *Groundwater quality, *Artesian wells, Fish farming, Ammonium compounds, Nitrites, Nitrogen compounds, Hydrogen sulfide, Manganese, Toxicity, Iron, Pumps, Pump wells, Water quality, Japan.

Since the establishment of the Inland station (Tamaki campus) of the National Research Institute of Aquaculture in 1979, the rearing water for experimental fishes has been supplied by four artesian wells in the campus. Prior to the establishment of the campus, assessment of the quality of groundwater around the campus had been done in 1973 and 1974. The quality of the artesian well water were reassessed in March of 1987, in order to examine changes in the quality with the passage of years. The levels of ammonium nitrogen, nitrite nitrogen, hydrogen sulfide, and manganese which are toxic to fish were below the level that is detrimental to fish health. The levels of total iron in the well water in 1987 were slightly higher than those in 1974. The increase in iron levels may be caused by rust release from pumping equipment submerged in each well. The present results indicate that, in spite of the increase in the pumped volume of groundwater around the Tamaki campus, the quality of artesian well water in the campus is almost unchanged compared with those in 1974, and that the water is suitable for fish culture. (Author's abstract)
W90-00649

ANALYSIS OF NONEQUILIBRIUM DESORPTION OF VOLATILE ORGANICS DURING FIELD TEST OF AQUIFER DECONTAMINATION.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5G.
W90-00873

FLOW INTERRUPTION: A METHOD FOR INVESTIGATING SORPTION NONEQUILIBRIUM.
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-00874

GROUNDWATER POLLUTION AND THE DISPOSAL OF HAZARDOUS AND RADIOACTIVE WASTES.
For primary bibliographic entry see Field 5E.
W90-00926

IMPACT OF PLASTIC MATERIALS ON IRON LEVELS IN VILLAGE GROUNDWATER SUPPLIES IN MALAWI.
Botswana Dept. of Water Affairs, Gaborone.
W. J. Lewis, and P. J. Chilton.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 82-88, February 1989. 4 fig, 7 ref.

Descriptors: *Drinking water, *Organoleptic properties, *Iron, *Plastics, *Rural areas, Groundwater quality, Malawi, Bacteria, Boreholes.

Iron is not normally considered to be a constituent of health significance, and recommended limits for iron in drinking water supplies are based on aesthetic considerations. Experience in Malawi has demonstrated that, even when present in only trace amounts, iron can influence the consumer's acceptance of an improved borehole supply. The effect of the use of plastic construction materials on the iron content of village groundwater supplies was investigated using a statistical approach. The majority of groundwater points using only plastic materials was found to supply water containing less than the WHO guideline value of 0.3 mg/L iron. In contrast, the use of ferrous materials increased the iron content of the water to unacceptable levels, sometimes causing the consumers to reject the borehole as a source of drinking water. Bacteriological data show that the quality of the alternative, traditional supply is far inferior to the new improved supply. An otherwise perfectly safe supply may therefore be abandoned as a direct result of contamination introduced by 'down the hole' components. This frustrates efforts to improve the well-being of rural communities, and is a waste of precious development resources. (Author's abstract)
W90-00930

DEPTH DISTRIBUTION OF AN APPLIED TRACER IN GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
A. Grassia.
Journal of Hydrology (New Zealand), Vol. 27, No. 1, p 26-34, 1988. 3 fig, 9 ref.

Descriptors: *Groundwater movement, *Model studies, *Infiltration, *Mathematical models, *Tracers, Field tests, Phreatic zone, Transport, Water depth.

A general mathematical model is proposed for the study of water transport in soil, in field experiments using tracers. The model can be used with tracer concentrations having different distributions, as might occur either shortly or sometime after tracer application, in field experiments where the phreatic zone lies close to the surface. This model better aproximates the physical conditions of heterogeneous soils and a shallow water table than previous models, and deals with multiple peaks. The only limitation of the model is that an impermeable layer is assumed at or near the depth of the phreatic zone, instead of a change from a transport to a diffusion process. (Author's abstract)
W90-00933

ALGORITHM FOR THE INTERPRETATION OF GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
A. Grassia.
Journal of Hydrology (New Zealand), Vol. 27, No. 1, p 35-43, 1988. 2 fig, 3 ref.

Descriptors: *Infiltration, *Tracers, *Groundwater movement, *Groundwater, Mathematical models, Depth, Gaussian curves, Rainfall.

Field experiments on the depth distributions of a tracer solute in sandy soil under general conditions were carried out with special consideration given to the effects of multiple pulses and the proximity of the solute to the phreatic zone. The depth distribution of a tracer is analysed utilizing a general mathematical model proposed in a previous paper, and applied to two illustrative examples: (1) two pulses, with a phreatic zone at infinite depth; and (2) three pulses, with a phreatic zone at 8 m depth. Core sections of equal length were assumed; however, the procedure can be easily extended to core sections of unequal length. The data were constructed by roughly sketching two Gaussian curves and then adding ordinates for chosen depths. Changes in the curve from a downward to an upward or flattening trend indicate the presence of two and three pulses respectively. A downward trend changing sharply to upward indicates proximity to the phreatic zone. Factors such as heavy rainfalls following application of the tracer, or knowledge from previous experiments of the approximate depth of the phreatic zone should be taken into consideration to confirm changes in trends of the tracer concentraion distribution function. (White-Reimer-PTT)
W90-00934

GROUNDWATER MODEL OF THE NUBIAN AQUIFER SYSTEM.
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
M. Heinl, and P. J. Brinkmann.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 425-447, August 1989. 13 fig, 9 ref.

Descriptors: *Geohydrology, *Model studies, *Water yield, *Finite element method, *Hydrologic models, *Groundwater mining, *Aquifer systems, Recharge, Paleohydrology, Africa.

The origin of the vast amount of water of the Nubian aquifer system in northeast Africa has been under controversial discussion among hydrogeologists. Does the water flow under more or less steady state conditions from intake beds in the humid Tibesti mountains or in the Ennedi mountains in Chad. Or was it recharged locally in the vicinity of the present oases during an earlier more humid climate so that present extraction actually means groundwater mining under unsteady conditions. An answer from a hydrodynamic point of view is presented using a two-dimensional horizontal finite element groundwater model simulating large-scale flow from the Chad to the Qattara depression. It includes a leakage concept for the confined northern part in order to simulate possible recharge in the vicinity of the east Saharian depressions during humid phases. According to steady state simulations, infiltration solely in the southern highlands does not suffice to maintain the presently observed water levels. Large-scale flow from the Chad highlands to the Oattara depression is insignificant. Thus the system was mainly filled by local recharge. A calibration for the 1960-1980 period was carried out on the model in order to adjust geological system parameters in the vicinity of the Egyptian depressions. An 80 years simulation for the future extraction of planned pumping centres in Egypt and Libya leads to the conclusion that there will be little interference between them in the unconfined part but a common drawdown cone in the Egyptian New Valley area. Some water extracted in Egypt will be draw from Sudan and Libya. The existing projects in Egypt and Libya extract about 0.5 km3 year-1, being the same order of magnitude as the natural groundwater discharge. The combined future projects would extract 5 km3 year-1, which is about ten times the natural outflow. Thus these projects would changed the natural groundwater flow system completely. A comprehensive explanation of the aquifer behavior seems to indicate a groundwater age far beyond the apparent 14C ages. Groundwater mainly flows between regions of (former) recharge and discharge. The presently extracted groundwater of the Egyptian oases was formed to a great extent during several humid phases in the unconfined part of the Nubian Aquifer in southwest Egypt. This part of the aquifer has been in a depleting process for several thousand years. (Author's abstract)
W90-00940

OPTIMIZATION APPROACH FOR GROUNDWATER QUALITY MONITORING NETWORK DESIGN.
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7A.
W90-00943

RADON IN GROUNDWATER: A TOOL TO ASSESS INFILTRATION FROM SURFACE WATER TO AQUIFERS.
Paul Scherrer Inst., Villigen (Switzerland).
E. Hoehn, and H. R. Gunten.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1795-1803, August 1989. 3 fig, 6 tab, 30 ref.

Descriptors: *Groundwater, *Surface-groundwater relations, *Aquifers, *Infiltration, *Tracers, *Radioactive tracers, *Radon, Groundwater recharge, Radioactive dating, Switzerland.

We measured the concentrations of natural 222Rn (half-life 3.8 days) in groundwater at three sites in Switzerland; here groundwater is recharged mainly by river waters. Upon infiltration and movement in the ground, the radon concentration in the water increases by more than two orders of magnitude to reach a steady state. This increase was found at two of three sites. At the site of main interest, we used the ingrowth of radon between the river and nearby observation wells to estimate groundwater residence times of up to about four half lives. We assumed that the ingrowth of radon can be described by the growth law of radioactivity, that the progenitors of radon (226Ra, 238U) are homogeneously distributed in the aquifer, and that the freshly infiltrated water is not mixed significantly with older groundwater. A linear regression through the data at the site of main interest yielded an average flow velocity of 4.6 m d-1, which confirms earlier tracer observations. Radon accumulates to higher concentrations, when the top soil layer is frozen or exhibits a high moisture content. During these conditions the radon cannot be used for dating purposes. (Author's abstract)
W90-00945

MEASURING GROUNDWATER TRANSPORT THROUGH LAKE SEDIMENTS BY ADVECTION AND DIFFUSION.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
R. J. Cornett, B. A. Risto, and D. R. Lee.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1815-1823, August 1989. 7 fig, 1 tab, 46 ref.

Descriptors: *Groundwater movement, *Flow measurement, *Lake sediments, *Advection, *Surface-groundwater relations, *Diffusion, Interstitial water, Sediment-water interfaces, Radioactivity techniques.

A method for estimating low rates of groundwater inflow and outflow through the bottom sediments of surface waters was developed and tested. A one-dimensional advection-diffusion model was fitted to measured pore water profiles of two nonreactive solutes, tritiated water and chloride, and the advection rate was calculated by a nonlinear least squares technique. Using 3H profiles measured 0-0.5 m below the sediment water interface, rates of groundwater advection into a lake through interbedded sands and gyttja were estimated to be about 1.0 m/year. In midlake locations underlain by soft organic gyttja, rates of advection were much lower (<0.1 m/year). Knowledge of the rate and direction of groundwater flow substantially altered the interpretation of pore water profiles within the sediments and the fluxes of solutes. This technique can be used to estimate flow rates less than 2 m/annum with minimal disturbance, without enclosing the sediments in a container, in a diversity of systems. (Author's abstract)
W90-00947

LAPLACE TRANSFORM GALERKIN TECHNIQUE: A TIME-CONTINUOUS FINITE ELEMENT THEORY AND APPLICATION TO MASS TRANSPORT IN GROUNDWATER.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
E. A. Sudicky.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1833-1846, August 1989. 8 fig, 38 ref.

Descriptors: *Path of pollutants, *Geochemistry, *Model studies, *Groundwater movement, *Solute transport, *Finite element method, *Laplace equation, Numerical analysis, Galerkin method, Porous media.

A time-continuous numerical technique, referred to as the Laplace Transformation Galerkin (LTG) method, is developed and applied to the problem of solute transport in porous media. After application of Galerkin's procedure and subdivision of the domain into finite elements, the method involves a simple application of the Laplace transformation to eliminate the temporal derivatives appearing in the space-discretized set of ordinary differential equations. Then, by solving the resulting transformed system of algebraic equations in Laplace p space, numerical inversion of the Laplace-transformed nodal concentration is performed using the robust and accurate Crump algorithm. The Crump algorith permits the concentration to be evaluated from a range of time values from a single set of Laplace p space solutions. Because each of the needed p space solutions are independent, the algorithm is well suited for execution on multiprocessor parallel computers. It is demonstrated by means of a series of examples that the LTG scheme is capable of providing highly accurate solutions essentially devoid of numerical dispersion for grid Peclet numbers in excess of 30. Examination of the complex-valued, Laplace-domain concentration profiles reveal that they are generally smooth, well-behaved oscillatory functions compared to the profiles in the time domain, thus permitting the use of a coarse finite element grid. Because of the nature of the Laplace transformation, the LTG method is particularly well suited to the problem of transient groundwater flow and solute transport in fractured porous media or multiple aquifer-aquitard systems based on the dual-porosity integro-differential equation approach. (Author's abstract)
W90-00949

SCALE DEPENDENCE OF CONTINUUM MODELS FOR FRACTURED BASALTS.
Westinghouse Hanford Co., Richland, WA. Environmental Div.
R. Khaleel.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1847-1855, August 1989. 14 fig, 23 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Geologic fractures, *Basalts, *Model studies, *Fracture permeability, Porous media, Scale factor.

Numerical simulations are carried out to determine the scale above which an equivalent porous medium (EPM) model can be used to represent flow through the dense interiors of fractured basalts. Steady laminar flow is assumed to occur through the interconnected network of conduits formed by the intersecting column-defining fracture patterns of the basalt dense interiors. The basalt rock matrix is considered to be impermeable. A porous medium equivalence is established in terms of fluid (Darcian) fluxes. A polar plot for the equivalent hydraulic conductivity is used to test whether a given fractured basalt system can be approximated as an EPM. For interconnected colonnade network models of filled or unfilled fractures with a lognormal aperture (b. millimeters) distribution (mean ln b = -1.945 and ln b = 0.896). EPM models can be justified at length scales of approximately 22 and 27 times the column diameter, respectively. The computed equivalent K values for clay-filled fractures compared favorably with the field-measured data. However, it is not intuitively obvious at what scale an EPM approximation is valid for a specific network. It should be emphasized that this study considered only the

primary cooling fractures of the dense interiors. At the very near-field scale (i.e., a few meters to tens of meters) considered in this study, a model comprised of an interconnected network of filled fractures may not be an unlikely representation of flow through the dense interiors. At the near field (i.e., a few hundred meters to a kilometers), the effects of the primary cooling fractures may be overshadowed by the possible presence of the intermediate to large scale tectonic features, such as steep through-going tectonic fractures and faults. Because of the size and spacing of these tectonic features, the modeling of fluid flow for the near and far fields can generally be accomplished by building these discrete features into a porous continuum model. (Shilder-PTT)
W90-00950

MATCHING A FIELD TRACER TEST WITH SOME SIMPLE MODELS.
Auckland Univ. (New Zealand). Dept. of Theoretical and Applied Mechanics.
D. P. Bullivant, and M. J. O'Sullivan.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1879-1891, August 1989. 10 fig, 2 tab, 29 ref.

Descriptors: *Dispersion, *Tracers, *Groundwater movement, *Radioactive tracers, *Model studies, Porous media, Geothermal studies, New Zealand.

Simple models of fluid flow and dispersion in a porous rock matrix are compared and used to match the results of tracer tests at the Wairakei (New Zealand) geothermal field. It is found that models which allow transient diffusion from fractures into the surrounding rock matrix give a better match to test results than either a model which allows only longitudinal dispersion or a pseudo steady state double porosity model. For some tests a model which includes two fractures is required to match the field data. (Author's abstract)
W90-00953

CHARACTERIZATION AND ISOTOPIC COMPOSITION OF ORGANIC AND INORGANIC CARBON IN THE MILK RIVER AQUIFER.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
E. M. Murphy, and S. N. Davis.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1893-1905, August 1989. 6 fig, 7 tab, 56 ref.

Descriptors: *Water chemistry, *Groundwater movement, *Path of pollutants, *Tracers, *Geochemistry, *Carbon, *Aquifers, Stable isotopes, Organic carbon, Inorganic carbon.

Carbon isotope analyses were performed by accelerator mass spectrometry on fractions of dissolved organic carbon (DOC) in groundwater from the Milk River aquifer. Alberta, Canada. The DOC was separated into high molecular weight (HMW) and low molecular weight (LMW) fractions for analysis. Characterization information and 14C activities suggest that the HMW fractions (primarily humic substances) originate in the interstitial waters of the soil zone in the area of recharge and are transported through the porous media of the aquifer. Transformations of HMW fractions down the flow path, including an increase in carbon, decrease in oxygen, and a pronounced increase in a the aliphatic nature of this fraction, are consistent with decreasing 14C activity. The LMW fractions show a dominant kerogen origin. This fraction of the DOC has low 14C activities (generally $< 1\%$ modern carbon), and gas chromatograh/mass spectrometry analyses identified a homologous series of substituted alkanes, further evidence that these compounds may have originated from organic-rich shales in the aquifer and/or confining beds. Geochemical and stable isotope measurements of the dissolved inorganic carbon (DIC) indicates that microbial activity is occurring in the Milk River aquifer. The alteration of these DIC 13C ratios by microbial activity render corrections for groundwater age in this aquifer difficult, if not impossible. Although 14C analyses of DOC fractions will not replace other groundwater dating techniques, these analyses do provide additional information on groundwater age and perhaps a more complete interpretation of groundwater age than DIC alone. (Author's abstract)
W90-00954

BOUNDARY CONDITIONS ALONG PERMEABLE FRACTURE WALLS: INFLUENCE ON FLOW AND CONDUCTIVITY.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
B. Berkowitz.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1919-1922, August 1989. 1 fig, 5 ref.

Descriptors: *Groundwater movement, *Geohydrology, *Model studies, *Fracture permeability, *Hydraulic conductivity, Fluid flow, Porous media, Boundary conditions.

It is usually assumed in the literature that an impermeable parallel plate approximation is suitable for modeling groundwater flow in permeable wall fractures. Experimental evidence which casts doubt on the validity of this assumption is examined, and a alternative formulation for flow in permeable wall fractures and the surrounding porous medium is developed. Analysis of the model indicates that assuming that the tangential fracture fluid velocity vanishes along the interface between fracture and porous medium can in certain cases lead to significant underestimation of the net flow rate and of the coefficient of equivalent fracture conductivity. (Author's abstract)
W90-00956

2G. Water In Soils

RAINFALL ABSTRACTION AND INFILTRATION IN NONPOINT SOURCE POLLUTION.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00004

LATERAL MOVEMENTS OF VADOSE WATER IN LAYERED SOILS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00005

SIMPLE MODEL FOR ASSESSING ANNUAL SOIL EROSION ON HILLSLOPES.
Silsoe Coll. (England).
For primary bibliographic entry see Field 2J.
W90-00008

SOME ASPECTS OF SOIL EROSION MODELLING.
Centro di Studio per la Genesi Classificazione e Cartografia del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2J.
W90-00009

DISTRIBUTION OF GASES AND HYDROCARBON VAPORS IN THE UNSATURATED ZONE.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 5B.
W90-00036

CAPACITIES AND MECHANISMS OF SORPTION OF ORGANIC COMPOUNDS BY WATER-SATURATED AND UNSATURATED SOILS.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00056

DATA FOR ASSESSMENT OF EVAPOTRANSPIRATION AND SOIL WATER.
New South Wales Univ., Kensington (Australia). Dept. of Water Engineering.
For primary bibliographic entry see Field 2D.
W90-00121

GROUND CONDUCTIVITY MEASUREMENTS ADJACENT TO THE KESTERSON PONDS 1, 2, AND 5.
Lawrence Berkeley Lab., CA. Earth Sciences Div.
N. E. Goldstein, D. Alumbaugh, and S. M. Benson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-014041. Price codes: A03 in paper copy, A01 in microfiche. Report No. LBL--24657, April 1988. 25p, 9 fig, 2 tab, 10 ref. DOE Contract DE-AC03-76SF00098.

Descriptors: *Reservoirs, *Water pollution sources, *Selenium, *Soil properties, *Conductivity, *Soil water, *Salinity, *Kesterson Reservoir, California, Irrigation water, Groundwater, Subsurface mapping.

A reconnaissance ground conductivity survey was performed by Lawrence Berkeley Laboratory (LBL) over the Freitas Ranch property adjacent to Ponds 1, 2, and 5 of the Kesterson Reservoir, Merced County, California. The purposes of the survey were to determine the background electrical conductivity of near-surface soils and rocks and to search for anomalies that could be attributed to the infiltration of irrigation drainwater from the Kesterson ponds into the native groundwater beneath the ranch. Soil conductivities indicated by direct-reading electromagnetic instruments (approximately 7, 15 and 30 m) provided by the instruments. Similar background readings have been reported for the Mendota area. Several individual conductivity anomalies of 300 to 400 micro-Siemens/m (mS/m) were mapped within the area. The only one that correlates with a surface features occurs over an oxbow depression at the south end of the survey area. The depression appears to have been periodically flooded; mud cracks and salt crystals are visible at the surface. The size of the anomaly decreases with the depth of investigations, indicating a surficial cause. An extensive conductivity anomaly adjacent to Pond 2 (lines 1, 2, 3, 4, and 5) is well-defined for all three depths of investigation. On the basis of anomaly shape, location, and magnitude, the authors conclude that the high conductivity is due, at least in part, to seepage of drainwater from Pond 2. The leading edge of the plume extends approximately 350 m from the San Luis Drain. East and north of the Freitas Ranch buildings and corrals, two discrete conductivity anomalies were detected on at least two lines. The narrow, slightly arcuate shapes of these anomalies suggest that they may be due to old stream channels. Whatever their cause, they are shallow features. (Lantz-PTT)
W90-00139

VARIATION OF SOIL WATER REGIME, OXYGEN STATUS AND ROOTING PATTERN WITH SOIL TYPE UNDER SITKA SPRUCE.
Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W90-00324

MINERAL COMPOSITION OF A TYPICAL CHERNOZEM WITH REGULAR FERTILIZATION AND IRRIGATION.
For primary bibliographic entry see Field 3F.
W90-00339

EFFECT OF IRRIGATION RATE ON SOLUTE TRANSPORT IN SOIL DURING STEADY WATER FLOW.
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 3F.
W90-00352

PREDICTION OF NITRATE LEACHING FROM A STRUCTURED CLAY SOIL USING TRANSFER FUNCTIONS DERIVED FROM EXTERNALLY APPLIED OR INDIGENOUS SOLUTE FLUXES.
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 5B.

W90-00353

SIMPLE EMPIRICAL MODEL OF ROOT WATER UPTAKE.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 2I.
W90-00355

CALIBRATION OF FREQUENCY-DOMAIN ELECTROMAGNETIC INDUCTION METERS AND THEIR POSSIBLE USE IN RECHARGE STUDIES.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 7B.
W90-00365

WATER FLOW IN A HUMMOCKY LANDSCAPE IN CENTRAL SASKATCHEWAN, CANADA: I. DISTRIBUTION OF WATER AND SOILS.
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
For primary bibliographic entry see Field 2E.
W90-00369

EVOLUTION OF THE SNOW COVER AND OF THE SOIL HYDROLOGICAL AND THERMAL PROFILES IN A BASIN OF THE LAURENTIDIAN BALSAM FIR FOREST (EVOLUTION DU COUVERT DE NEIGE ET DES PROFILS HYDRIQUE ET THERMIQUE DU SOL DANS UN BASSIN DE LA SAPINIERE LAURENTIDIENNE).
Centre de Recherches en Biologie Forestiere, Departemente des Sciences Forestieres, Universite Laval, Que, G1K 7P4, Canada.
For primary bibliographic entry see Field 2C.
W90-00371

CANOPY SHADING EFFECTS ON SOIL HEAT AND WATER FLOW.
Iowa State Univ., Ames. Dept. of Agronomy.
R. Horton.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 669-679, May/June 1989. 8 fig, 1 tab, 43 ref.

Descriptors: *Canopy, *Soil temperature, *Heat transfer, *Soil water, *Model studies, *Air-earth interfaces, *Heat flow, Weather data collections, Evaporation, Numerical analysis, Simulation.

A method to model two-dimensional heat and water flow in soil as influenced by shading from a row crop is developed. The numerical method predicts the surface energy partitioning, soil temperature, and the water content as influenced by soil surface evaporation in the absence of water uptake by roots. Standard weather information, canopy shape factors, and soil thermal and hydraulic properties are the inputs required to make predictions. Although the present model does not include water uptake by roots, this feature can be added. The methods of prediction are compared with analytical methods in verification and benchmarking test problems. Predictions of soil surface temperature and subsurface temperature in a verification test scenario closely agree with analytical solution values. Predicted soil water contents during an infiltration event agree closely with analytical values predicted by a quasi-analytic simulator (used in a benchmarking test), and also with experimental data (used in a validation test). A 10-d simulation is performed to show the ability of the method to describe surface energy partitioning and soil profile conditions. The method is shown to provide reasonable results. For the specific scenario of this simulation, the diurnal time variation of surface energy partition, soil water content, and soil temperature exhibited a radical change when the soil located between plant rows dried to residual water content. Large spatial variations in soil energy fluxes, temperature, and water content are predicted when soil located between plant rows becomes drier than soil below the canopy. The method can predict these fluxes, which are very difficult to obtain by direct measurement. Thus, this method should have a wide range of application in soil and crop sciences. (Author's abstract)
W90-00378

SPATIAL VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY OF THE SUBSOIL OF TWO FORESTED WATERSHEDS.
Tennessee Univ., Knoxville.
G. V. Wilson, J. M. Alfonsi, and P. M. Jardine.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 679-685, May/June 1989. 5 fig, 3 tab, 34 ref.

Descriptors: *Forest hydrology, *Hydraulic conductivity, *Hydraulic properties, *Forest watersheds, *Soil water, *Soil porosity, Storm seepage, Saturation zone, Saturated flow.

Subsurface flow has been shown to be greater in soils with spatially dependent hydraulic properties. The spatial dependency in saturated hydraulic conductivity, K sub sat, of two potential shallow waste disposal sites in eastern Tennessee is quantified. The Guelph Permeameter was used to determine K sub sat of the subsoil of two forested watersheds, Walker Branch and Melton Branch. The simultaneous equations approach resulted in more than 50% negative K sub sat values and was concluded to be invalid for these forested subsoils. As an alternative, flux density was used as an index of the saturated hydraulic conductivity for spatial correlation analysis and for determination of scaling factors. The spatial realizations of hydraulic conductivity for both watersheds were found to be intrinsic random functions of order zero, i.e., stationary, with a generalized covariance function for Walker Branch consisting of a pure nugget and for Melton Branch a nugget with a linear term. Semivariograms revealed no spatial dependency for separation distances $>$ 4.2 m at Walker Branch. Spatial dependency at Melton Branch for separation distances $<$ 30 m was described by an exponential model. The hydraulic conductivity of Walker Branch subsoils had a greater arithmetic mean (0.000015 vs. 0.000076 m/s) and greater random variability than Melton Branch subsoils. These findings suggest that soils common to Walker Branch Watershed are hydrologically preferable for shallow waste disposal. (Author's abstract)
W90-00379

ORGANIC OXIDATION AND MANGANESE AND ALUMINUM MOBILIZATION IN FOREST SOILS.
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 2K.
W90-00380

MECHANISM OF NATIVE MANGANESE RELEASE IN SALT-TREATED SOILS.
North West Frontier Province Agricultural Univ., Peshawar (Pakistan). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-00381

GYPSUM OCCURRENCE IN SOILS ON THE MARGIN OF SEMIPERMANENT PRAIRIE POTHOLE WETLANDS.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2K.
W90-00383

GEOCHEMISTRY OF HYDRIC SOIL SALINITY IN A RECHARGE-THROUGHFLOW-DISCHARGE PRAIRIE-POTHOLE WETLAND SYSTEM.
North Dakota State Univ., Fargo. Dept. of Soil Science.
J. L. Arndt, and J. L. Richardson.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 848-855, May/June 1989. 9 fig, 2 tab, 40 ref.

Descriptors: *North Dakota, *Saline soils, *Geochemistry, *Wetlands, *Marshes, *Soil water, *Soil properties, *Geohydrology, Soil chemistry, Gypsum, Minerals, Groundwater recharge.

The saturation-paste extract (SPE) chemistry of samples collected in the wet-meadow and shallow-marsh zones of seven North Dakota wetlands was related to SPE electrical conductivity to investigate the development of hydric-soil salinity. Study wetlands represent a local, depression-focused groundwater-flow system. Recharge wetlands recharge the groundwater whereas discharge wetlands receive the majority of their water as groundwater discharge. Throughflow wetlands receive water from as well as yield water to the system. Development of soil salinity generally followed the Hardie and Eugster model of closed-basin brine evolution, which considers the composition of solutions undergoing evaporation to be the result of chemical changes imposed by the successive formation of evaporite minerals. Hydric soils of recharge wetlands were nonsaline and free of calcite (CaCO3) and gypsum (CaSO4-2H20). The chemistry of these soils results from evapotranspiration, recharge hydrology, ionic mobility, and exchange relationships. Increases in SPE Mg(2+), Na(+), and SO4(2-) dominance in more saline throughflow and discharge wetlands are caused by calcite and gypsum precipitation, with the former controlling alkalinity and the latter Ca(2+) concentrations. At high salinities produced by concentration through freezing, mirabilite (Na2SO4-10H2O) crystallizes and controls Na(+) levels, resulting in hypersaline solutions enriched in Mg(2+) and SO4(2-). Additional variation in the patterns of salinity development can be explained by dominance of recharge over discharge, mixing with fresh or chemically discrete water, and valence dilution effects. (Author's abstract)
W90-00384

PROCESSES AND RATES OF PEDOGENESIS IN SOME MARYLAND TIDAL MARSH SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
T. M. Griffin, and M. C. Rabenhorst.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 862-870, May/June 1989. 4 fig, 2 tab, 38 ref.

Descriptors: *Tidal marshes, *Wetlands, *Chesapeake Bay, *Soil profiles, *Soil organic matter, *Soil chemistry, Oxidation-reduction potential, Minerals, Pyrite, Sedimentation.

Tidal marsh profiles from various locations around the Chesapeake Bay were dated using 210Pb geochronology. These soils, which were classified as Typic and Terric Sulfihemists, Typic and Histic Sulfaquents, and Histic Hydraquents, were characterized with respect to bulk density, organic matter content, S and Fe speciation, and pyrite content. These characteristics were interpreted in the context of marsh accretionary activity and soil forming processes. Rates of vertical accretion ranged between 0.35 and 0.75 cm/yr, indicating that the marshes examined are keeping pace with published rates of sea level rise. Generally, those marshes accreting most rapidly contained a higher mineral content and a higher reactive Fe (FeS2-Fe plus 'free' Fe) content. Pyrite S and organic S were the dominant S species forming form the microbial reduction of SO4(2-). Redox conditions, Fe reactivity, organic matter content, and SO4(2-) concentrations were the major factors controlling S and Fe transformations. Models developed to define different marsh environments with respect to pyrite formation and the degree of pyritization illustrate that in those marshes receiving low rates of mineral sediments (i.e., slowly accreting marshes), the amount of reactive Fe is limiting FeS2 formation, the FeS2 content is low, degree of pyritization (Py) is high, and the dominant S species is organic S. Where the reactive Fe content is high (i.e., rapidly accreting marshes) and SO4(2-) reduction is not retarded, the FeS2 content is high and Py is moderate to high. If reactive Fe is high and SO4(2-) reduction is impeded for some reason, then FeS2 formation becomes limited by the SO4(2-) reduction rate, and the FeS2 content and Py will be variable. (Author's abstract)
W90-00385

FIELD TECHNIQUE FOR MEASURING WETLAND SOIL PARAMETERS.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 2H.
W90-00386

WETTABLE POROUS PLASTIC FOR USE AS A POROUS BARRIER IN SOIL HYDRAULIC STUDIES.
Ohio Agricultural Research and Development Center, Wooster. Dept. of Agronomy.
E. L. McCoy.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 979-981, May/June 1989. 1 fig, 1 tab, 11 ref.

Descriptors: *Barriers, *Semipermeable membranes, *Hydraulic conductivity, *Soil water, Soil properties, Hydraulic properties, Soil porosity, Plastics.

Two grades of wettable porous plastic were examined for their applicability in water characteristic measurements and other soil hydraulic studies. The porous plastic is available in sheets (0.46 m wide, arbitrary lengths) and the two grades are composed of different amounts of polyvinyl chloride (PVC) and silica. Grade A-20 exhibited a range of bubbling pressures between 62 and 69 kPa and a mean conductance of 0.20/h. Grade A-40 exhibited a range of bubbling pressures between 21 and 35 kPa and a mean conductance of 1.60/h. These conductances generally exceed that of commonly employed porous barriers with comparable bubbling pressures. Comparison of the water retention curves of grades A-20 and A-40 indicate that grade A-20 is more uniform, has lower porosity, and has smaller effective pore diameters with a narrower range of pore sizes. The porous plastic is easily cut to size by scissors and bonded to itself, PVC, or acrylic. The material is also durable and inexpensive. (Author's abstract)
W90-00389

MICROBIAL LIFE IN THE TERRESTRIAL SUBSURFACE OF SOUTHEASTERN COASTAL PLAIN SEDIMENTS.
Environment America, Inc., Augusta, GA.
C. B. Fliermans.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 155-171, Spring 1989. 28 ref. DOE contract no. DE-AC09-76SR00001.

Descriptors: *Water pollution treatment, *Soil organisms, *Sediments, *Microorganisms, *Microbiological studies, *Subsurface water, Biodegradation, Species diversity.

The distribution and function of microorganisms are vital issues in microbial ecology. The U.S. Department of Energy's PRogram, 'Microbiology of the Deep Subsurface', concentrates on establishing fundamental scientific information about organisms at depth, and the use of these organisms for remediation of contaminants in deep vadose zone and groundwater environments. The Biosphere is effectively extended by hundreds of meters into the Geosphere and a variety of subsurface activities (including bioremediation strategies) are implied. It is demonstrated that the terrestrial deep subsurface is a habitat of great biological diversity and activity. It is shown that microorganisms are present at depth and that the traditional scientific concept of an abiological terrestrial deep subsurface is not valid. The presence of microorganisms at depth has been shown by a variety of direct and indirect techniques and by a number of different investigators at various laboratories. The data demonstrated that the density of microorganisms does not decrease significantly with depth. Such information suggests that the Biosphere may extend a substantial distance into the Geosphere and only ceases to exist where temperature and pressure become the limiting factors for life. Microbial populations in these deep sediments are more active than had been expected for the scientific literature; an enhanced role might be expected for microorganisms that influence the groundwater chemistry and the geological processes. The diversity of the microbiological communities in deep terrestrial sediments is one of the most striking discoveries. Both structurally and functionally, a wide and diverse variety of metabolically active microorganisms were present and capable of transforming a variety of organic and inorganic compounds. Additionally, an extensive number of bacteria were isolated which may be new to the scientific community and, at the very least, provide investigators with a new source of genetic material from organisms adapted to living and metabolizing hundreds of meters below the earth's surface. (Miller-PTT)
W90-00464

PREDICTING THE AVERAGE MOVEMENT OF REACTIVE SOLUTES IN SOILS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 5B.
W90-00506

PREDICTING DEEP DRAINAGE IN THE SOIL FROM SOIL PROPERTIES AND RAINFALL.
Queensland Dept. of Primary Industries, Indooroopilly (Australia).
R. J. Shaw.
Soil Use and Management SUMAEU, Vol. 4, No. 4, p 120-123, December 1988. 2 fig, 12 ref.

Descriptors: *Soil water, *Infiltration, *Drainage, *Deep seepage, *Soil properties, *Rainfall, Hydraulic conductivity, Root zone, *Salts, *Model studies, Infiltration rate, Land use, Soil profiles, Water management, Deep seepage.

Simple predictions of deep drainage in the soil profile are often required for preliminary planning of land management where the cost of direct measurement is not warranted. Soil hydraulic conductivity and drainage of water below the root zone can be related to the salt content at the bottom of the root zone, assuming steady-state balances of water and salt. Since the hydraulic conductivity decreases markedly as the soil dries from saturation, the quantity of deep drainage is a product of the time that the soil remains at or near saturation and the rate of soil water movement. It is assumed that the salt content at the bottom of the root zone is in equilibrium with rainfall and thus variation due to salt in the parent material and mineral weathering are no longer significant, and short-term variations in the salt concentration of rainfall are insignificant. A physically based empirical model uses readily measured soil properties to predict the quantity of drainage below the root zone under varying regimes of water management and shows a good relationship with ponded infiltration rate. (Geiger-PTT)
W90-00507

APPLICATION OF THE THRESHOLD CONCENTRATION CONCEPT TO IRRIGATION WITH SALINE WATER.
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinity.
For primary bibliographic entry see Field 3C.
W90-00508

RELATIONSHIPS BETWEEN THE UNSATURATED ELECTRIC AND SATURATED HYDRAULIC PROPERTIES OF SOILS.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
W. E. Kelly, T. Gorman, and B. Curtis.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 115-123, July 1989. 7 fig, 1 tab, 13 ref. USGS grant 14-08-0001-G1133.

Descriptors: *Geophysics, *Geophysical surveys, *Electrical studies, *Soil water, *Groundwater recharge, *Groundwater management, *Vadose water, Electrical properties, Hydraulic properties, Saturation, Permeability.

A basis for relations between electric resistivity of unsaturated zone soils and their saturated hydraulic conductivity which could provide a basis for using electrical measurements to evaluate sites for artificial groundwater recharge, or for developing groundwater protection zones is presented. Interpretation of existing data demonstrates that the formation factors of unsaturated soils should provide an indicator of saturated permeability. Such relationships could be used in a semi-quantitative way to define areas of high and low recharge potential. Areas of low recharge potential would also be areas where groundwater pollution potential would be low. Therefore by mapping the electrical properties of vadose zones, recharge and pollution maps could be developed for management and protection of groundwater. Ideally, both the hydraulic and electrical properties of typical unsaturated sediments should be measured on undisturbed samples. This is feasible with fine-grained sediments but would be very difficult for coarse sediments. A good measure of equilibrium vadose zone moisture contents can be obtained from gravimetric moisture contents. However, porosities would still have to be estimated. In actual applications, the resistivity of water in the vadose zone is needed to calculate resistivities, or convert measured resistivities to formation factors. As most vadose zones are layered, the resistivities of individual layers will generally not be detected. Instead, average vadose zone values will be determined. These average values will be, in many cases, the most appropriate parameters for characterizing vadose zones. (White-Reimer-PTT)
W90-00581

INFLUENCE OF SIMULTANEOUS CHANGES IN SODICITY AND PH ON THE HYDRAULIC CONDUCTIVITY OF AN ALKALI SOIL UNDER RICE CULTURE.
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3F.
W90-00638

SOIL TEMPERATURE AND MOISTURE REGIME RELATIONSHIPS WITHIN SOME RANGELANDS OF THE GREAT BASIN.
Forest Service, Missoula, MT. Region 1.
M. E. Jensen, G. H. Simonson, and R. E. Keane.
Soil Science SOSCAK, Vol. 147, No. 2, p 134-139, 1989. 3 fig, 3 tab, 8 ref.

Descriptors: *Soil-water-plant relationships, *Soil water, *Soil temperature, *Plant populations, Plant growth, Range grasses, Soil moisture meters, Soil moisture deficiency, Arid-zone hydrology, Grasslands, Meadows, Limiting factors, Linear programming, Regression analysis, Nevada.

There has been limited quantitative information in the past on the correspondence between soil temperature and moisture and rangeland plant communities in the Great Basin. This deficiency in supporting data has frustrated soil and plant community classification efforts conducted on such land. Soil temperature and moisture data were collected between 1983 and 1986 on 35 rangeland sites of the Humboldt National Forest in northeastern Nevada. Sites were grouped into northern and southern slope classes for linear regression analyses of elevation with soil temperature. Predictive equations developed show that mesic soils extend up to 1591 meters on the northern side and up to 2024 meters on the southern side. Cryic soils are found 81 meters and 43 meters above these points, respectively. Frigid soils are not extensive. Aridic soil moisture regimes dominate most of the rangeland sites studied. The average number of days when soil temperature and moisture are not limiting to plant growth ranges from 28 to 32 days on Artemisia arbuscula sites, 50 to 56 days on A. tridentata vaseyana sites, 45 to 70 days on mixed mountain brush sites, and 130 days on a wet meadow site. The limited growing period is of critical importance to the management of such lands. (Author's abstract)
W90-00639

CARBOFURAN TRANSFER AND PERSISTENCE IN DRAINED AGRICULTURAL SOILS RELATED TO THEIR STRUCTURE AND ADSORPTION PROPERTIES.
Laboratoire de Protection des Cultures, Nancy (France).
For primary bibliographic entry see Field 5B.

W90-00686

ACCUMULATION OF POLY-BETA-HYDROXYBUTYRATE IN A METHANE-ENRICHED, HALOGENATED HYDROCARBON-DEGRADING SOIL COLUMN: IMPLICATIONS FOR MICROBIAL COMMUNITY STRUCTURE AND NUTRITIONAL STATUS.
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Oceanography.
For primary bibliographic entry see Field 5B.
W90-00725

RAPID BIOLOGICAL CLEAN-UP OF SOILS CONTAMINATED WITH LUBRICATING OIL.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W90-00765

CONCENTRATIONS AND FATE OF LINEAR ALKYLBENZENE SULPHONATE IN SLUDGE AMENDED SOILS.
Soap and Detergent Industry Association, Hayes (England).
For primary bibliographic entry see Field 5B.
W90-00833

FLOW INTERRUPTION: A METHOD FOR INVESTIGATING SORPTION NONEQUILIBRIUM.
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-00874

DIFFUSION OF INORGANIC CHEMICAL SPECIES IN COMPACTED CLAY SOIL.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00875

EFFECT OF WATER DEPTH IN GROUNDWATER RECHARGE BASINS ON INFILTRATION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, and R. C. Rice.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 556-567, August 1989. 4 fig, 8 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Infiltration rate, *Recharge basins, Hydraulic permeability, Water depth, Clogging, Detention time, Algal growth, Photosynthesis, Hydrogen ion concentration, Chemical precipitation, Calcium carbonate, Field tests.

Where groundwater is artificially recharged via infiltration basins, it is often desirable to maximize the hydraulic capacity of the basins to get as much water into the ground as possible. Sediment or organic clogging layers on the wetted perimeter are the rule rather that the exception for infiltration basins for artificial recharge of groundwater. When the water depth in such basins is increased, the clogging layer is compressed. This causes infiltration rates to increase much less than expected from the water depth increase alone, and rates may actually decrease. Such decreases are especially severe where the decreased turnover rate (increased detention time) of the water in the infiltration basins due to increasing the water depth leads to increased growth of suspended algae. These algae form a filter cake on the basin bottom. Also, because of photosynthesis, these algae increase the pH of the water, which can cause precipitation of calcium carbonate. This precipitate and the algal filter cake both aggravate the clogging problem and cause infiltration rates to decrease even further. Consolidation theory is used to explain the compression of the clogging layer. These conclusions are supported by field and laboratory studies. Careful analysis of the situation and on-site experimentation are needed to determine the optimum water depth for recharge basins. (Author's abstract)
W90-00881

SOLUTE MOVEMENT THROUGH ROOT-SOIL ENVIRONMENT.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2I.
W90-00885

INFILTRATION FUNCTION FROM FURROW STREAM ADVANCE.
Agricultural Research Service, Shafter, CA. Cotton Research Station.
For primary bibliographic entry see Field 3F.
W90-00894

TIME OF CONCENTRATION FORMULA FOR PERVIOUS CATCHMENTS.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 733-735, August 1989. 1 fig, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Routing, *Model studies, *Concentration time, *Irrigation engineering, *Agricultural engineering, *Infiltration, Mathematical models, Computers, Soil classification, Soil texture, Roughness coefficient, Surface water, Surface runoff, Physical properties, Pervious soils, Field tests.

A time-of-concentration chart for flow over pervious rectangular plots has been recently presented. This chart was developed using the results of a physically based mathematical model, and it can be easily employed for desktop calculations. An algebraic function would, however, be more convenient to use in computer applications. An explicit formula, which fits the time-of-concentration chart previously reported is presented, using physically based parameters. Soil characteristics can be obtained from soil texture data, and the effective roughness factor is available for a variety of natural and agricultural surfaces. Verification of this equation should be verified with field data. (Fish-PTT)
W90-00895

SOIL EFFECTS ON WATER CHEMISTRY IN THREE ADJACENT UPLAND STREAMS AT GLENDYE IN NORTHEAST SCOTLAND.
Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-00912

SOIL MOISTURE DEFICITS IN SOUTH-CENTRAL SWEDEN: I. SEASONAL AND REGIONAL DISTRIBUTIONS.
Linkoeping Univ. (Sweden).
L. Andersson.
Nordic Hydrology NOHYBB, Vol. 20, No. 2, p 109-122, 1989. 6 fig, 1 tab, 17 ref.

Descriptors: *Drought, *Soil moisture deficiency, *Sweden, *Model studies, *Soil water, Mathematical models, Recharge, Soil absorption capacity, Statistical analysis.

Some commonly used assumptions about climatically induced soil moisture fluxes within years and between different parts of a region were challenged with the help of a conceptual soil moisture model. The model was optimized against neutron probe measurements from forest and grassland sites. Five 10 yrs and one 105 yrs long climatic records, from the province of Ostergotland, situated in south-central Sweden, were used as driving variables. It was concluded that some of the tested assumptions should not be taken for granted. Among these were the beliefs that interannual variations of soil moisture contents can be neglected in the beginning of the hydrological year and that soils usually are filled up to field capacity after the autumn recharge. The calculated climatic induced dryness was estimated to be rather insensitive to the choice of climatic stations within the region. Monthly ranges of soil moisture deficits (1883-1987) were shown to be skewed and it is therefore recommended to use medians and standard deviations in statistical analyses of 'normal' ranges of soil moisture deficits. (See also W90-00921) (Author's abstract)
W90-00920

SOIL MOISTURE DEFICITS IN SOUTH-CENTRAL SWEDEN: II. TRENDS AND FLUCTUATIONS.
Linkoeping Univ. (Sweden).
L. Anderson.
Nordic Hydrology NOHYBB, Vol. 20, No. 2, p 123-136, 1989. 7 fig, 2 tab, 20 ref.

Descriptors: *Drought, *Soil moisture deficiency, *Sweden, *Soil water, *Model studies, *Soil-water-plant relationships, Forests, Grasslands, Climatology, Statistical models, Frequency analysis, Acidity.

Soil moisture fluxes in forest and grassland soil were analyzed for a rather dry region in south-central Sweden in order to assess climatologically induced dryness variability. Time series were constructed, using a conceptual soil moisture model, optimized against neutron probe measurements. Data in a 105 yrs climatic record were used as driving variables. A method to deal with the inhomogeneity of the long precipitation record was developed. It was shown that large variations existed, not only between the median values, but even more for the range of the quartiles, depending on the choice of time period. The statistical distribution varied significantly even between the two 50 yrs series, where the latter showed larger fluctuations around the median caused by a trend towards increased amount of high summer soil moisture deficits. Estimates of the interannual variations of possible water deficit stress on vegetation were made. The only time (1883-1987) when there was a calculated risk for drought stress on the forest during four consecutive years was during 1973-1976. This might have increased the vulnerability to the threats of acidification. It was concluded that the use of standard and return periods can hardly be justified as no sets of average conditions exits. (See also W90-00920) (Author's abstract)
W90-00921

DEPTH DISTRIBUTION OF AN APPLIED TRACER IN GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2F.
W90-00933

ALGORITHM FOR THE INTERPRETATION OF GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2F.
W90-00934

RADON IN GROUNDWATER: A TOOL TO ASSESS INFILTRATION FROM SURFACE WATER TO AQUIFERS.
Paul Scherrer Inst., Villigen (Switzerland).
For primary bibliographic entry see Field 2F.
W90-00945

SALT REDISTRIBUTION DURING FREEZING OF SALINE SAND COLUMNS AT CONSTANT RATES.
Alaska Univ., Fairbanks. Geophysical Inst.
G. C. Baker, and T. E. Osterkamp.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1825-1831, August 1989. 7 fig, 24 ref.

Descriptors: *Soil water, *Saline soils, *Soil columns, *Sand, *Freezing, *Salt rejection, Particle size, Soil solution, Brines.

Columns of sand with grain sizes from about 250 to 600 um were saturated with a sodium chloride solution with a concentration of 35 parts/thousand (ppt) and frozen at constant rates ranging from 1 to 20 mm d-1. Electrical conductivity of the soil solution, water content, and temperature were measured during the experiments. The interface between the frozen and unfrozen regions was sharply defined and mechanically hard with no evidence for a soft, ice-bearing transition region, thicker than a millimeter. Ice content near the interface was less than 50%. Substantial salt redistribution occurred with downward freezing but not with upward freezing. For downward freezing, the amount of salt rejected near the interface decreased with increasing freezing rate and increased with the salinity of the soil solution in the unfrozen region. Salt redistribution consisted of salt rejection and brine drainage from an extended partially frozen region just above the interface. Brine drained from this partially frozen region until the ice content reached about 900-950 ppt. Brine drained through the interface and mixed-rapidly in the unfrozen region, apparently by salt fingering. No evidence could be found for a salt-enriched layer just below the interface. There was a layer just above the interface, moving with it, which was undersaturated at low and oversatured at high freezing rates. An effective distribution coefficient may be used in describing salt redistribution during freezing of saline sands. (Author's abstract)
W90-00948

LEACHING OF N AND C FROM BIRCH LEAF LITTER AND RAW HUMUS WITH SPECIAL EMPHASIS ON THE INFLUENCE OF SOIL FAUNA.
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 2K.
W90-00961

2H. Lakes

USE OF DETRENDED CORRESPONDENCE ANALYSIS TO IDENTIFY FACTORS THAT AFFECT THE STRUCTURE OF AQUATIC COMMUNITIES.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W90-00057

EFFECTIVENESS OF LIMING TO MITIGATE LAKE-WATERSHED ACIDIFICATION.
Electric Power Research Inst., Palo Alto, CA. Environmental Science Dept.
For primary bibliographic entry see Field 5G.
W90-00065

MERCURY LEVELS IN WALLEYES FROM WISCONSIN LAKES OF DIFFERENT WATER AND SEDIMENT CHEMISTRY CHARACTERISTICS.
Wisconsin Dept. of Natural Resources, Madison. Water Resources Research Section.
For primary bibliographic entry see Field 5B.
W90-00078

DESIGNING COST-EFFECTIVE HABITAT MANAGEMENT PLANS USING OPTIMIZATION METHODS.
National Ecology Center, Fort Collins, CO.
For primary bibliographic entry see Field 6A.
W90-00123

1986 LAKE POWELL SURVEY.
Bureau of Reclamation, Denver, CO. Surface Water Branch.
For primary bibliographic entry see Field 2J.
W90-00126

SOME BASIC INFORMATION FOR THE MANAGEMENT OF URBAN LAKES NEAR PERTH, WESTERN AUSTRALIA.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W90-00130

FORMULATION OF WATER QUALITY MODELS FOR STREAMS, LAKES, AND RESERVOIRS: MODELER'S PERSPECTIVE.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, R. B. Ambrose, and M. S. Dortch.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-211198. Price codes: A05 in paper copy, A01 in microfiche. Miscellaneous Paper E-89-1, July 1989. Final Report. 78p, 7 fig, 1 tab, 180 ref.

Descriptors: *Water quality, *Model studies, *Lakes, *Streams, *Reservoirs, *Mathematical models, Hydrodynamics, Sediment transport, Organic compounds, Surface water, Nutrients.

An overview of process descriptions, assumptions, constraints, and other considerations that enter into the development of deterministic mathematical surface water quality models is given in this report. Modeling of hydrodynamic transport is treated separately for 'standing' waters (lakes, reservoirs, ponds, and impoundments) and flowing waters (rivers and streams). Some information on sediment transport as it relates to water quality is presented. Models addressing organic wastes and nutrients, synthetic organic chemicals, and metals transport and transformation are addressed in separate sections. The review ends with an outlook toward challenges and possible future developments. (Author's abstract)
W90-00145

RELATIONS BETWEEN QUALITY OF URBAN RUNOFF AND QUALITY OF LAKE ELLYN AT GLEN ELLYN, ILLINOIS.
For primary bibliographic entry see Field 4C.
W90-00212

LIMING PROJECT HAERSKOGEN 1976-1986: WATER CHEMICAL AND BIOLOGIC RESPONSE ON LIMING IN SEVEN WEST SWEDISH LAKES (KALKNINGSPROJEKTET HARSKOGEN 1976-1986: VATTENKEMISK OCH BILOGISK RESPONS PA KALKNINGSATGARDER I SJU VASTSVENSKA SJOAR).
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5G.
W90-00270

INCREASED HEAT ABSTRACTION FROM LAKES DURING THE WINTER: METHODS OF ACCELERATING ICE FORMATION ON LAKES IN ORDER TO INCREASE THE AMOUNT OF ENERGY STORED IN THEM DURING THE WINTER (UKAD SUOVARME PA VINTERN: METODER ATT PASKYNDA ISLAGGNINGEN I SJOAR FOR HOGRE ENERGIINNEHALL VINTERTID).
Swedish Council for Building Research, Stockholm.
S. Lindahl, J. Svensson, and M. Morberg.
Available from National Technical Information Service, Springfield, VA 22161 as DE88753671/GAR. Price codes: A03 in paper copy, A01 in microfiche. Contract BFR-R-8-1987, 1987. 26p, 23 fig, 1 tab. English summary.

Descriptors: *Lake Ice, *Sweden, *Water circulation, *Lakes, Wind-driven currents, Flow barriers, Density stratification, Density currents, Booms.

The objective of this work has been to investigate the theoretical and practical feasibility of reducing the effects of wind-induced mixing. The theoretical work has considered the use of artificial flow barriers and the feasibility of influencing the ice formation process by means of 'artificial' density stratification by supplying extremely cold surface water to the lake. The work showed that both methods should give favorable results. Practical work consisted of testing the use of flow barriers, which in this case consisted of oil-collecting booms. The results indicated that booms have a beneficial effect on the ice formation process. Reliably quantifiable energy gains could not be measured, due to the large natural variations in the lake heat content from year to year. However, the conclusion was that the effect of booms must be favorable due to the demonstrated acceleration of the ice formation process. (Author's abstract)
W90-00277

DISTRIBUTION AND ACTIVITY OF PICOPHYTOPLANKTON IN A BRACKISH ENVIRONMENT.
Messina Univ. (Italy). Dept. di Biologia Animale ed Ecologia Marina.
L. A. Pomar, V. Bruni, F. Decembrini, G. Giuffre, and T. L. Maugeri.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 129-138, 1988. 5 fig, 25 ref.

Descriptors: *Saline lakes, *Photosynthesis, *Productivity, *Limnology, *Plankton, *Phytoplankton, *Brackish water, Picoplankton, Photosynthetic bacteria, Bacteria, Algae, Italy, Distribution patterns.

The picophytoplankton in the brackish lake of Faro (Messina, Italy) were studied with particular attention given to the autotrophic component and its activity in relation to seasonal variation of environmental, biotic, and abiotic factors. The results of direct counts of the Faro lake water samples show that the autotrophic population of the picoplankton was three times lower in number with respect to the total picoplankton for nearly the whole period of the study. The values of the total photosynthetic rates obtained in this study confirm the high productivity of this brackish water environment compared to the sea nearby. The contribution of the picoplankton to the total assimilation of carbon in the lake of Faro, average value of 38%, appears considerably lower than that found both in Italian seas and in open oceanic waters. The biomass, expressed as chlorophyll a, of the autotrophic picoplankton with respect to the total, was considerably lower than that of other marine environments. In the brackish water environment at Faro it appears that the phytoplankton fraction is more efficient in using reduced illumination. (Gadsby-PTT)
W90-00284

CHEMICAL COMPOSITION AND NUTRIENT LOADING BY PRECIPITATION IN THE TRACHYPOGON SAVANNAS OF THE ORINOCO LLANOS, VENEZUELA.
Universidad Simon Bolivar, Caracas (Venezuela). Dept. de Estudios Ambientales.
For primary bibliographic entry see Field 2K.
W90-00304

SEASONAL VARIATION OF METHANE EMISSIONS FROM A TEMPERATE SWAMP.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
J. O. Wilson, P. M. Crill, K. B. Bartlett, D. I. Sebacher, and R. C. Harriss.
Biogeochemistry BIOGEP, Vol. 8, No. 1, p 55-71, January 1989. 6 fig, 1 tab, 37 ref. NASA Biospheric Research Program NAS116673.

Descriptors: *Wetlands, *Methane, *Swamps, *Temperate zone, Fluctuations, Seasonal variation, Interstitial water.

Methane flux measurements were made at four sites in a freshwater temperate swamp over the 13-month period of April 1985 through May 1986. Emissions were highly variable both between sites and over time at any one site. Ebullition from sediments was an important component of methane release. Although release of methane through bubbling occurred in only 19 % of the measurements made between April and June 1985, when instru-

mentation allowed us to separate diffusive and bubble fluxes, ebullition accounted for 34 % of the total flux during this period. Methane release rates showed a strong seasonal variation, with highest emission rates observed in early spring and again in late summer, which was associated with changes in plant growth and physiology. Emission rates were partially correlated with sediment temperature, but the relationship was not straightforward, and resembled a step function. Emissions responded strongly to temperature change through the range of 10-16 C. At winter sediment temperatures between 4-9 C, CH4 flux continued at low rates (0-28 CH4/sq m/day; average=7.9 mg CH4/sq m/day) and appeared insensitive to changes in sediment temperature. Annual methane emission from three constantly flooded sites (mean water depth=35 cm) was 43.7 +/-7.8g/sq m (standard error); annual flux from a bank site was 41.4 =/-20.5 g/sq m. A comparison of flux measurements from fresh and saline wetlands in the immediate area of Newport News Swamp emphasizes the importance of edaphic factors in controlling flux. (Author's abstract)
W90-00306

SEASONAL AND INTER-ANNUAL VARIATIONS OF NITROGEN DIAGENESIS IN THE SEDIMENTS OF A RECENTLY IMPOUNDED BASIN.
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
G. Billen, S. Dessery, C. Lancelot, and M. Meybeck.
Biogeochemistry BIOGEP, Vol. 8, No. 1, p 73-100, January 1989. 15 fig, 1 tab, 22 ref, append.

Descriptors: *Storage reservoirs, *Lake sediments, *Cycling nutrients, *Limnology, *Nitrogen, *Diagenesis, *Sediment-water interfaces, Oxygen, Nitrates, Ammonium, Seasonal variation, Nitrogen cycling, France.

The Mery-sur-Oise (France) storage reservoir is an artificial basin of 9 m average depth, fed by water from the river Oise with a mean residence time of about four days. Sediments are accumulating at a rate of about 0.7 cm/month. In the sediments, two fractions of organic nitrogen with different rates of bacterial degradation could be distinguished, one associated with fresh phytoplankton, the other made of detrital and more refractory compounds. The fluxes of oxygen, nitrate and ammonium across the sediment-water interface were measured with a bell-jar system at different seasons during a 3-year period following flooding of the basin. The measurements showed clear seasonal variations in relation with the variations of temperature and input of fresh phytoplanktonic material to the sediment. In addition, a long term trend of increasing ammonium was observed. Measurements were also carried out after dredging of all accumulated sediments of the basin. They showed a considerable reduction of the flux of nitrate to the sediments and a significant reduction of the flux of ammonium to the water column. These results are interpreted in the light of a non-stationary model of N diagenesis in accumulating sediments. This model is able to predict at least the general trends of benthic N cycling of basins during the early stage of their ecological succession. (Author's abstract)
W90-00307

HYDROLYSIS OF CHLOROSTILBENE OXIDE: I. HYDROLYSIS IN HOMOGENEOUS SYSTEMS.
Georgia Univ., Athens.
For primary bibliographic entry see Field 5B.
W90-00309

CHARMED LIFE OF A LAKE CALLED PRAIRIE ROSE.
For primary bibliographic entry see Field 5G.
W90-00327

EPIPHYTIC MICROALGAE ON NATURAL SUBSTRATA IN A HARDWATER LAKE: SEASONAL DYNAMICS OF COMMUNITY STRUCTURE, BIOMASS AND ATP CONTENT.
North Carolina State Univ., Raleigh. Dept. of Botany.
J. M. Burkholder, and R. G. Wetzel.
Archiv feur Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 1, p 1-56, 1989. 24 fig, 15 tab, 123 ref, append.

Descriptors: *Limnology, *Ecosystems, *Lakes, *Aquatic environment, *Aquatic plants, *Algae, *Biomass, Seasonal variation, Cycling nutrients, Population dynamics, Macrophytes.

Epiphytic algal community composition, biovolume, pigment concentrations and ATP content were characterized throughout an annual cycle, from outer leaves of the submersed sedge Scirpus subterminalis in a hardwater, phosphorus-limited north temperate lake. On outer Scirpus leaves, maximum ATP levels of microbial epiphytes were attained two weeks after new ramets appeared. ATP content was positively correlated with algal biomass only on aging macrophyte tissue. Blue-green algae contributed a mean of 88% of the total algal cells, whereas diatoms comprised a mean of 90% of the total epiphytic algal biovolume. Blue-green algae were a negligible portion of the algal biomass except during autumn, when they contributed 40$ of the total. However, blue-greens were estimated to produce more than 50% of the total algal carbon; and epiphytic chlorophyll resulted primarily from blue-green algae, except on the oldest leaf tissue and during colder periods. The seasonal dynamics of the epiphytic community proceeded through five phases over the course of macrophyte growth, senescene and death. Epiphytic algae were estimated to contribute a major proportion of the total primary production in the lake. (Author's abstract)
W90-00340

LONG-TERM AND SHORT-TERM VARIATION IN THE PHYSICAL AND CHEMICAL LIMNOLOGY OF A LARGE, SHALLOW, TURBID TROPICAL LAKE (LAKE CHAPALA, MEXICO).
Centro Estudios Limnologicos, Guadalajara (Mexico).
J. G. Limon, O. T. Lind, D. S. Vodopich, R. Doyle, and B. G. Trotter.
Archiv feur Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 1, p 57-81, 1989. 8 fig, 5 tab, 63 ref. NSF Grant INT821349.

Descriptors: *Limnology, *Ecosystems, *Lakes, *Lake stages, *Dissolved solids, Turbidity, Hydrologic cycle, Cycling nutrients, Seasonal variation.

Interannual variation in the physical and chemical limnology of Lake Chapala, Mexico was much greater than seasonal variation. This long-term variation was not due to stochastic events but to diversion of water for agriculture in the principal watershed. These greatly reduced inputs produced an extended (5 yr) decline in water volume of the lake with concomitant increases in all measured dissolved solids except for inorganic nitrogen. Evaporation has become the principal source of water loss. Short-term variation was strongly determined by the wet and dry season differences and by wind driven circulation patterns. Water chemistry and turbidity each varied across Lake Chapala's shallow and continuously homothermal basin. However, spatial variation in chemical properties was much less than that of turbidity. The greatest differences in turbidity were between the eastern region of the lake, which is shallower and near the source of riverine input, and the rest of the lake. Because of the long-term evaporative concentration, most chemical components (phosphorus, inorganic carbon, calcium, etc.) were present in high concentrations. The lake has a relative depth of only 0.02% which makes it highly susceptible to wind-driven advection of dissolved materials, thus the chemical components varied only slightly across the lake. Seasonal variation in these chemical components also was relatively small (CV < 15%) and related directly to rainy season dilution and dry season evaporative concentration. Seasonal variation in turbidity also related directly to rainy and dry seasons. Lower turbidity was present during the rainy season due to the significant deepening of the lake and the consequent lessening of clay resuspension; even for such a large lake, consequences of diverting of waters from the riverine source upon water quality are evident. The interannual changes that resulted from such diversion serve as a cautionary model for possible future diversions of water inputs to other tropical lakes. (Author's abstract)
W90-00341

RESOURCE UTILIZATION OF COEXISTING SPECIES OF HYDROPHSYCHIDAE (TRICHOPTERA).
Lund Univ. (Sweden). Stream and Bethic Ecology Group.
L. B. Petersen.
Archiv feur Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 1, p 83-119, 1989. 10 fig, 5 tab, 59 ref.

Descriptors: *Limnology, *Ecosystems, *Aquatic environment, *Food chains, *Caddisflies, *Aquatic insects, *Life cycles, Seasonal variation, Survival, Stream biota, Growth stages.

Life histories, monthly production and food utilization were determined for three species of the net spinning caddisfly Hydropsyche in Lerbacken, a headwater stream in south Sweden. All three species were univoltine but were separated in time by differences in larval instar development. Total hydropsychid production, estimated by the size frequency method, was 4.0 g DM/yr. Hydropsyche saxonica had an annual production of 1.4 g DM, H angustipennis produced 0.4 g DM and H. siltalai made up 2.2 g DM of the total. Based on gut analysis, preferred food items in spring were microcrustacea, macroinvertebrates and detritus-diatom aggregates. In summer this changed to Keratella and Peridinium with microcrustacea and invertebrates having another peak in late fall. Over an annual cycle, each species experienced some period when preferred items were not in abundance. A combination of resources, temperature, food quality and life cycle schedule was found to explain differences in production of the three species. However, the increase of a resource did not result in a comparable increase in the dependent variable, growth and/or survival. Instead, it can be thought of as a binary system of either on when resources are above a certain threshold level and with growth and/or survivorship occurring, or off, with growth and/or survivorship not occurring. This allows a simple explanation of how several resources, independent variables can act together to control populations. (Author's abstract)
W90-00342

BURBOT, LOTA LOTA, OF VILYUYSK RESERVOIR.
Akademiya Nauk SSSR, Yakutsk. Inst. of Biology.
A. F. Kirillov.
Journal of Ichthyology JITHAZ, Vol. 28, No. 2, p 49-546, 1988. 6 tab.

Descriptors: *Limnology, *Reservoirs, *Aquatic animals, *Fish populations, *Ecology, *Aquatic populations, Food chains, Aquatic environment, Species composition.

Vilyuysk Reservoir (USSR) is a channel type of reservoir with a surface are of 2170 sq km and a volume of 35 cu km. It was constructed in 1977 on the Vilyuy River 1335 km from its mouth. A thermocline forms in the reservoir in mid-summer. The difference in temperature between the epilimnion and hypolimnion may be 10-12.5 C at depths of 35-60 m. Burbot (Lota lota), which is sensitive to environmental temperature, has been forced to move from the littoral zone to the hypolimnion. Detailed information is provided on the adaptation of burbot to the reservoir. Roach and perch, the most common species in the reservoir, are the main food of the burbot. The composition of the burbot diet is determined by competition with other fishes: in the 1970s, maximum competition developed with whitefish, and subsequently pike became the main competitor, with a food similarity value of 75.7 in summer and 81.8 in winter. The high growth rate is evidence of the successful adaptation of burbot to the ecological conditions of the Vilyuysk Reservoir. (Friedmann-PTT)

W90-00375

OBSERVATIONS ON THE DOWNSTREAM MOVEMENT OF JUVENILE FISHES IN THE ATREK RIVER.
For primary bibliographic entry see Field 2E.
W90-00376

GYPSUM OCCURRENCE IN SOILS ON THE MARGIN OF SEMIPERMANENT PRAIRIE POTHOLE WETLANDS.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2K.
W90-00383

GEOCHEMISTRY OF HYDRIC SOIL SALINITY IN A RECHARGE-THROUGHFLOW-DISCHARGE PRAIRIE-POTHOLE WETLAND SYSTEM.
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W90-00384

FIELD TECHNIQUE FOR MEASURING WETLAND SOIL PARAMETERS.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
S. P. Faulkner, W. H. Patrick, and R. P. Gambrell.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 883-890, May/June 1989. 7 fig, 33 ref. US Army Corps of Engineers Waterways Experiment Station Contract DACW 39-81-6-0032.

Descriptors: *Wetlands, *Soil physical properties, *Soil properties, *Oxidation-reduction potential, *Soil water table, On-site data collections, Sampling, Iron, Soil chemistry.

Delineating wetlands from nonwetlands in seasonally inundated ecosystems is often difficult and requires data on soil functions and attributes. Techniques (including equipment design, construction, and installation) for assessing wetland soil attributes have been developed that allow direct field measurements of soil O2 content, oxidation-reduction potential, water-table depth, and presence of ferrous iron. Soil O2 content is measured from diffusion chambers with a specially fitted polarographic probe. Redox potential is measured with permanently installed platinum electrodes and a voltmeter. Determination of water-table depth may require piezometers in addition to unlined observation wells. The presence of ferrous iron can be detected with alpha,alpha,-dipyridyl and indicates anaerobic conditions, although interpretation and extrapolation of results must be carefully made. These parameters are particularly diagnostic and results of field studies reveal their dynamic nature and utility in wetland delineation efforts. (Author's abstract)
W90-00386

KINETIC ANALYSIS OF PROTEIN DEGRADATION BY A FRESHWATER WETLAND SEDIMENT COMMUNITY.
Michigan Univ., Ann Arbor. Dept. of Biology.
H. W. Cunningham, and R. G. Wetzel.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 1963-1967, August 1989. 3 fig, 20 ref. Department of Energy grant DE-FG02-87ER-60515 and NSF grant IBMS-75-20322.

Descriptors: *Nutrients, *Limnology, *Wetlands, *Proteins, *Amino acids, *Microbial degradation, *Mineralization, Sediments, Kinetics.

The mineralization of proteins by the sediment microflora of a freshwater wetland conformed to a kinetic model developed for polymer degradation. The maximum velocity of protein mineralization ranged from 2,078 to 147 nmol of protein/cu cm/h from May to October. The turnover time of protein was 13 t 69 h. A statistical comparison of the kinetic parameters by the standard error of the estimate demonstrated that protein degradation exhibited significant random fluctuations throughout the growing season. The fluctuations were related to changes in the concentration of readily degradable protein as estimated by K sub t. Utilization of amino acids was 9 to 57 times greater than the utilization of protein, and the turnover time for amino acids was 1.6 to 3.7 h. (Author's abstract)
W90-00392

SEASONAL CYCLE OF THERMOCYCLOPS CRASSUS (FISCHER, 1853) (COPEPODA:CYCLOPOIDA) IN A SHALLOW, EUTROPHIC LAKE.
Ulm Univ. (Germany, F.R.). Dept. of Biology III.
G. Maier.
Hydrobiologia HYDRB8, Vol. 178, No. 1, p 43-58, July 10, 1989. 12 fig, 5 tab, 48 ref.

Descriptors: *Copepods, *Eutrophic lakes, *Thermocyclops, *West Germany, Seasonal variation, Population density, Reproduction, Water temperature, Gronne Lake.

The seasonal cycle of Thermocyclops crassus was studied from 1985-87 in the Gronne, a shallow productive lake. T. crassus was present from late April to early October, while water temperature was above 10 C. It produced three generations per year. Population peak was usually reached by the second generation, in August. Abundance was positively correlated with water temperature. Females carried 18.3 to 32.3 eggs on average. Reproduction rates were highest in July and August. Sex ratio was low, as females generally outnumbered males. Between October and April copepodites 4 went in diapause, predominantly in the deepest part of the lake and 0-4 cm deep in the bottom mud. Variations in body size were low across the year. T. crassus coexisted with the cyclopids, Cyclops vicinus and Mesocyclops leuckarti. In 1985 and 1986, abundances of M. leuckarti were low, while those of T. crassus and C. vicinus were high. In 1987 lower water temperatures, caused by cold weather, resulted in a marked decrease of the population density of T. crassus, while the abundance of M. leuckarti increased, and density of C. vicinus remained high. Comparison of the egg duration times of T. crassus, C. vicinus and M. leuckarti showed that at 15 C and below T. crassus may be outcompeted by its comparatively longer egg development times. However, experiments in limnocorrals showed that T. crassus has an advantage over C. vicinus when fish predation is high. (Author's abstract)
W90-00402

CHEMICAL MODELLING APPLICATIONS TO EXPERIMENTAL RECIRCULATING STREAMS.
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2K.
W90-00403

ATLANTIC SALMON (SALMO SALAR) SMOLT PRODUCTION IN A NEWFOUNDLAND RIVER SYSTEM CHARACTERIZED BY LACUSTRINE HABITAT.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
For primary bibliographic entry see Field 8I.
W90-00407

CENTRAL ASIAN IRRIGATION CANALS AND SOME ASPECTS OF THEIR ALGAL FLORA.
Tashkent State Pedagogical Inst. Nizami SSR. Dept. of Botany.
A. E. Ergashev.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 7, No. 1, p 83-94, 1989. 7 fig, 2 tab, 24 fig.

Descriptors: *Algae, *Irrigation canals, *Algal growth, *Water chemistry, Optical properties, Physical properties, Solar radiation, Water temperature, Transparency, Flow, Salinity, Floods, Seasonal variation, Diatoms, Cyanophyta, Species composition.

Of the factors governing algal growth in Central Asian canals, light and temperature are known to be determinative because other environmental factors are at their optimum. However, as solar radiation increases and temperature rises in the late spring and early summer, the flood period starts. The water rises in rivers and canals, its transparency sharply decreases, the flow rate increases, and salinity is reduced. Conversely, as solar radiation and temperature decrease in autumn, the discharge diminishes and the water level, flow, transparency, and salinity increase. Phytoplankton is normally lacking in these canals due to the low transparency. However, phytobenthic associations have been found at depths down to 1 m. In the flood period (spring and early summer) algal abundance drops sharply due to the loss of transparency. In the late summer and early autumn, the canals are characterized by high abundance and great species diversity of algae as a result of the higher transparency. In late autumn, cell numbers and diversity decrease due to the declining temperature and, in numerous distributing canals, the cessation of water supply. Diatoms, blue-green algae and green algae dominate among the algal flora of the canals. The biotic structure changes along the length of the canals. On canals fed by mountain rivers, only 10-12% of the total number of algal species occur along the full length. Most species are confined to the upper reaches. As the water runs downwards, its turbidity rises and results in the gradual disappearance of many algae species. In canals fed by lowland rivers there is no great difference in the physicochemical conditions along the full length and, consequently, no substantial longitudinal gradient in species composition. (Author's abstract)
W90-00408

VARIATION OF PHYTOPLANKTON IN A TROPICAL ESTUARY (VELLAR ESTUARY, BAY OF BENGAL, INDIA).
Annamalai Univ., Annamalainagar (India). Centre of Advanced Study in Marine Biology.
P. Mani, and K. Krishnamurthy.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 7, No. 1, p 109-115, 1989. 1 fig, 4 tab, 18 ref.

Descriptors: *Phytoplankton, *Estuaries, *India, Species composition, Species diversity, Diatoms, Dinoflagellates, Chlorophyta, Cyanophyta, Chrysophyta, Salinity, Seasonal variation, Vellar Estuary, Bay of Bengal.

A study of phytoplankton species composition and community structure was carried out in the marine and gradient zone of Vellar estuary from January to December, 1983. The phytoplankton community consisted of diatoms (90 species), dinoflagellates (21 species), Chlorophyceae (3 species), Cyanophyceae (2 species) and Chrysophyceae (1 species). Diatoms were always dominant in the population. Important dominant species included Pleurosigma elongatum, P. mormanii, Rhizosolenia spp., Thalassionema nitzschioides and Thalassiothrix frauenfeldii. Of the various factors, salinity seems to have the most influence on the composition of phytoplankton species. Species diversity ranged between 0.7 and 4.2 units/individual, and was lowest in the monsoon season and highest in summer. Generally species diversity was influenced more by the distribution of individuals among the species (eveness) than the number of species or salinity. Higher eveness values coincided with low dominance indices and vice versa, supporting the definition of eveness as opposed to the dominance index. (Author's abstract)
W90-00409

APPLICATION OF THE QWASI (QUANTITATIVE WATER AIR SEDIMENT INTERACTION) FUGACITY MODEL TO THE DYNAMICS OF ORGANIC AND INROGANIC CHEMICALS IN LAKES.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5B.
W90-00435

EFFECT OF THE MICROBIAL POPULATION SIZE ON THE DEGRADATION OF LINEAR

ALKYLBENZENE SULFONATE IN LAKE WATER.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
For primary bibliographic entry see Field 5B.
W90-00441

ROLE OF THE MISSISSIPPI RIVER IN WETLAND LOSS IN SOUTHEASTERN LOUISIANA, U.S.A.
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
For primary bibliographic entry see Field 6G.
W90-00446

ESTIMATION OF MIXING RATES IN WESTERN LAKE ONTARIO SEDIMENTS BY FINITE ELEMENT ANALYSIS OF 210PB PROFILES.
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2J.
W90-00447

MICROBIAL LIFE IN THE TERRESTRIAL SUBSURFACE OF SOUTHEASTERN COASTAL PLAIN SEDIMENTS.
Environment America, Inc., Augusta, GA.
For primary bibliographic entry see Field 2G.
W90-00464

EFFECT OF PARTICLE SIZE, CHEMISTRY AND MINERALOGY OF RIVER SEDIMENTS ON PHOSPHATE ADSORPTION.
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W90-00503

CORRESPONDENCE BETWEEN THE DISTRIBUTION OF FISH ASSEMBLAGES IN WISCONSIN STREAMS AND OMERNIK'S ECOREGIONS.
Wisconsin Dept. of Natural Resources, Fitchburg.
J. Lyons.
American Midland Naturalist AMNAAF, Vol. 122, No. 1, p 163-183, July 1989. 4 fig, 6 tab, 43 ref. Wisconsin Dingell-Johnson Project F-83-R, Study RS043.

Descriptors: *Wisconsin, *Fish populations, *Aquatic habitats, *Aquatic environment, *Fish management, *Resources management, Omerniks ecoregions, Statistical analysis, Multivariate analysis.

Most of Wisconsin is in four of the ecoregions devised by Omernik which are based on similar land-surface form, soils, potential natural vegetation and land use, and are used for aquatic resources management. Multivariate analyses of fish and habitat data from three size-classes of streams in western and southern Wisconsin were used to evaluate the correspondence between ecoregions and geographic patterns in the distribution of fish assemblages. Overall, correspondence was better than expected by chance, and improved with increasing stream size. For all three size-classes of streams, agreement between the ecoregion classification of sampling stations and a classification based on a nonhierarchical cluster analysis of fish species abundance data was statistically significant. Detrended correspondence analysis ordinations of fish data showed differences among sampling stations that were associated with ecoregion membership. Catches of several fish species differed significantly among ecoregions, even with conservative significance levels. However, the ecoregion classification was fairly imprecise, and some sampling stations were more similar to stations in other ecoregions than they were to stations in their own ecoregion. Thus, in Wisconsin, ecoregions will be most useful in setting management policies for broad geographic areas containing many streams, and less useful in dealing with limited geographic areas and individual streams. Several analyses suggested that data on four general habitat characteristics, water temperature, stream gradient, substrate composition and shoreline vegetation characteristics, could be used to develop a more precise classification of Wisconsin streams. However, unlike the ecoregion classification, this classification would probably be applicable only to Wisconsin and only to fish assemblages. (Author's abstract)
W90-00520

STATE OF AN ARID IRRIGATION RESERVOIR STALKED WITH WASTEWATER EFFLUENT AND STORM INDUCED FLOWS.
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00544

ISOLATION OF SAPROLEGNIACEAE FROM TIGRIS RIVER AND NOTES ON THEIR OCCURRENCE IN WINTER SEASON.
Biological Research Center, Baghdad (Iraq). Dept. of Hydrobiology.
A. N. Butty.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 5, p 505-513, July 1989. 1 fig, 4 tab, 15 ref.

Descriptors: *Species composition, *Iraq, *Aquatic fungi, *Tigris River, Temperature, Saprolegniaceae, Achlya, Saprolegnia, Dichtyuchus, Calyptralegnia, Oospores.

A field study of Saprolegniaceae was designed to determine the distribution of these fungi in the Tigris River and the environmental factors influencing their occurrence. Monthly samples were collected from three stations from November 1987 to February 1988. Of the genera identified from the isolated fungi, Achlya and Saprolegnia had the greatest species diversity with seven and three species, respectively. The twelve species identified were: Achlya prolifera, A. aff. caroliniana, A. polyandra, A. americana, A. racemosa, A. treleaseana, A. debaryana, Saprolegnia ferax, S. uliginosa, S. terrestris, Dichtyuchus magnusii, and Calyptralegnia riparіensis. A. polyandra was the most abundant species. Out of 153 isolates 63 reached sexual maturity. Oospore type is the major morphological factor correlated with seasonal periodicity of many species in this fungi family. Temperature is the most important single factor determining the occurrence of fungi, and a negative correlation was observed between number of isolates and temperature (r = -0.72) with the highest number of isolates occurring in December and January. (White-Reimer-PTT)
W90-00545

CONTRIBUTION OF PICOPLANKTON TO PRIMARY PRODUCTION AND THE CONTENT OF CHLOROPHYLL 'A' IN EUTROPHIC WATERS AS EXEMPLIFIED BY SEVASTOPOL BAY.
Institute of Biology of the Southern Seas, Sevastopol (USSR).
L. V. Stelmakh.
Oceanology ONLGAE, Vol. 28, No. 1, p 95-99, 1988. 14 ref.

Descriptors: *Phytoplankton, *Primary productivity, *Sevastopol Bay, *Eutrophic waters, *Chlorophyll a, Seasonal variation, Picoplankton, Oligotrophic waters, Size variation.

The contribution of picoplankton to primary production and the content of chlorophyll a in eutrophic waters as exemplified by the Bay of Sevastopol was studied. Samples were collected from April 1985 to March 1986 every 10 to 20 days and filtered through a nylon sieve with a cell diameter of 150 microm to remove large-size zooplankton. In the bay, production of phytoplankton were subject to great variations both within each season and from season to season. The share of primary production and chlorophyll a created by picoplankton (0.45-2.5 microm) was on the average 20-44% during the year, which was approximately half the level of the oligotrophic waters of the ocean. Picoplankton of the waters studied was represented by eucaryotes with a cell diameter generally in the 2-3 microm range. The contribution of the minutest fraction of phytoplankton (0.43-0.85 microm) to primary production and the content of chlorophyll a was insignificant, amounting to 0-4%. It is supposed the level of biogenic supply and, consequently, the trophicity of waters determine the percentage of primary production and chlorophyll a contributed by picoplankton: the more oligotrophic the waters, the greater the contribution of the picoplankton to the primary productivity. (White-Reimer-PTT)
W90-00547

STORAGE-YIELD RELATIONSHIPS FOR RESERVOIRS BY A SEQUENTIAL-OPERATION ALGORITHM AND COMPARISONS WITH GOULD'S PROBABILITY MATRIX METHOD.
Cukurova Univ., Adana (Turkey). Dept. of Civil Engineering.
T. Haktanir.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 43-56, July 1989. 6 fig, 2 tab, 15 ref.

Descriptors: *Reservoir operation, *Reservoirs, *Reservoir capacity, *Reservoir storage, *Turkey, *Algorithms, Gould method.

An algorithm was developed to compute the no-shortage storage capacity versus any regulation including lake evaporation losses and dead storage. Six stations in the Seyhan Basin were put into one group and six stations in the Ceyhan Basin were put in another group. Each group was run separately using the monthly streamflow simulation package, HEC-4, to obtain 1000-yr long synthetic records. Results of this procedure indicated that storages from about 50-yr long historical records of the twelve streams in Turkey were much greater than 1% risk storages of Gould's probability matrix method. It is argued that the Gould method underestimates the necessary storages. Once an appropriate synthetic flow generation method suitable to the streams in question is found, 1000-yr or longer synthetic records can be generated and split into many n-yr segments. By applying a sequential-operation type of algorithm to each one of these segments, so many storages versus any regulation can be obtained, to which a probability model can be fit, and a critical storage value with the desired exceedence probability can be found. Later, any risk storages computed in this manner can be divided by no-failure storage of the single historical record, and practical ratios can be determined (White-Reimer-PTT)
W90-00576

RELATIONSHIP BETWEEN SEDIMENTARY DIATOM ASSEMBLAGES AND LAKEWATER PH IN 35 QUEBEC LAKES, CANADA.
Trent Univ., Peterborough (Ontario). Trent Aquatic Research Centre.
A. S. Dixit, S. S. Dixit, and R. D. Evans.
Journal of Paleolimnology, Vol. 1, No. 1, p 23-38, July 1988. 6 fig, 3 tab, 41 ref.

Descriptors: *Diatoms, *Lake sediments, *Hydrogen ion concentration, *Acid rain effects, *Quebec, *Acidity, *Acidification, *Paleolimnology, Species composition, Regression analysis, Mathematical models.

Surface sediment diatoms from 35 soft-water lakes in southern Quebec were studied to examine the relationship with lakewater pH. The lakes ranged in pH from 5.25 to 7.66. The species composition and relative abundance of diatoms in the study lakes are found to be closely related to pH and/or factors closely associated with pH. Predictive models were developed to infer lakewater pH using simple linear regression equations of index alpha, index B, and multiple regressions using pH preference categories. Among the predictive models examined, the multiple regression technique provided the highest correlation coefficient (r squared = 0.88) and the lowest standard error (0.26 of a pH unit) in computing diatom-inferred pH. This model appears to be the most appropriate to reconstruct lake pH histories in the Quebec region. (Author's abstract)

W90-00591

ESTIMATION OF PH OPTIMA AND TOLERANCES OF DIATOMS IN LAKE SEDIMENTS BY THE METHODS OF WEIGHTED AVERAGING, LEAST SQUARES AND MAXIMUM LIKELIHOOD, AND THEIR USE FOR THE PREDICTION OF LAKE ACIDITY.

Kuopio Univ. (Finland). Dept. of Environmental Hygiene.
J. Oksanen, E. Laara, P. Huttunen, and J. Merilainen.
Journal of Paleolimnology, Vol. 1, No. 1, p 39-49, July 1988. 3 fig, 3 tab, 31 ref.

Descriptors: *Diatoms, *Lake sediments, *Hydrogen ion concentration, *Acid rain, *Finland, *Acidity, *Acidification, Least squares method, Weighted averaging method, Maximum likelihood method, Mathematical models.

Ecological optima and tolerances with respect to autumn pH were estimated for 63 diatom taxa in 47 Finnish lakes. The methods used were weighted averaging (WA), least squares (LS) and maximum likelihood (ML), the two latter methods assuming the Gaussian response model. WA produces optimum estimates which are necessarily within the observed lake pH range, whereas there is no such restriction in ML and LS. When the most extreme estimates of ML and LS were excluded, a reasonably close agreement among the results of different estimation methods was observed. When the species with unrealistic optima were excluded, the tolerance estimates were also rather similar, although the ML estimates were systematically greater. The parameter estimates were used to predict the autumn pH of 34 other lakes by weighted averaging. The ML and LS estimates including the extreme optima produced inferior predictions. A good prediction was obtained, however, when prediction with these estimates was additionally scaled with inverse squared tolerances, or when the extreme values were removed (censored). Tolerance downweighting was perhaps more efficient, and when it was used, no additional improvement was gained by censoring. The WA estimates produced good predictions without any manipulations, but these predictions tended to be biased towards the centroid of the observed range of pH values. At best, the average bias in prediction, as measured by mean difference between predicted and observed pH, was 0.082 pH units and the standard deviation of the differences, measuring the average random prediction error, was 0.256 pH units. (Author's abstract)
W90-00592

STANDING CROP AND PROCESSING OF RAINFOREST LITTER IN A TROPICAL AUSTRALIAN STREAM.

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Zoology.
R. G. Pearson, R. K. Tobin, R. E. W. Smith, and L. J. Benson.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 4, p 481-498, June 1989. 4 fig, 2 tab, 38 ref.

Descriptors: *Rain forests, *Australia, *Streams, *Litter, *Standing crops, *Leaves, *Macroinvertebrates, *Tropical regions, Caddisflies, Riffles, Seasonal variation, Yuccabine Creek.

Standing crop of litter in Yuccabine Creek, an Australian upland rainforest stream, varied from 2.4 0.5 to 11.5 2.7 g dry wt per 1/16 sq m, was greatest in the late dry season (October, early summer), and differed substantially between years, because of variations in retention rate rather than in litterfall. Predominant macroinvertebrates in natural litter packs (82% by numbers) were caddis larvae (Trichoptera: Leptoceridae and Calamoceratidae) which appeared to be the main shredders of leaf litter. Rates of litter processing in the stream were estimated using artificial litter packs of single or mixed species and of fresh or aged leaves. Macroinvertebrates accounted for up to 77% of processing after 64 days (aged leaves), but there was great variation between experiments according to differences in leaf species, pool or riffle environments, and time of year. The most rapid processing resulted in a processing coefficient (-k) value of 0.017, and 50% decay value (T50) of 32 d for fresh leaves of mixed species. For aged leaves (pre-leached) the greatest decay rate produced a T50 value of 32 d (the exponential model was inapplicable so -k could not be calculated in this case). The slowest processing (estimated T50 > 400 d) was for fresh Rhodamnia sessiliflora leaves. There was no apparent relationship between temperature and processing rate in the field, but this result may have been due to a great abundance of litter in summer. The observed variation in the results was caused largely by local factors such as leaf species, the presence, abundance and distribution of shredders, and the temporal changes in standing crop of litter and abundance of shredders. (Author's abstract)
W90-00593

BIOGEOCHEMICAL SURVEY OF RIVERS AND STREAMS IN THE MOUNTAINS AND FOOT-HILLS PROVINCE OF ARCTIC ALASKA.

University Coll. of North Wales, Bangor. School of Biological Sciences.
M. A. Lock, T. E. Ford, D. M. Fiebig, M. C. Miller, and M. Hullar.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 4, p 499-521, June 1989. 9 fig, 2 tab, 39 ref.

Descriptors: *Biochemistry, *Limnology, *Cold regions, *Alaska, *Arctic, *Mountains, *Tundra, *Rivers, *Streams, *Geochemistry, *Water chemistry, *Microorganisms, Organic compounds, Organic carbon, Amino acids, Phosphorus, Calcium, Sodium, Magnesium, Nitrogen, Nitrates, Nitrites, Ammonium, Chlorophyll a, Hydrogen ion concentration, Conductivity, Aquatic bacteria, Spectral analysis.

Ten rivers and streams were sampled in the mountain and foothills provinces of arctic Alaska in the vicinity of the Brooks Mountain range. Emphasis was upon the organic composition of the water including dissolved organic carbon (OC), apparent molecular weight (AMW) fractions (0.7 micron-300 K, 300-50 K, 5-10 K, 10-1 K and < 1 K), UV-visible absorption spectra and free dissolved amino acids. Analyses for conductivity, pH, alkalinity, soluble reactive P, NO3-N, NO2-N, NH4-N, Ca, Mg, K and Na were also carried out. Waters were also monitored for chlorophyll-a content, bacterial densities and suspended microbial activity. The mountain and foothills rivers were separable on the basis of dissolved OC content with low concentrations (0.18-1.84 mg OC/l) in the mountains and high concentrations (2.27-8.41 mg OC/l) in the foothills, AMW spectra (foothills water characterized by its higher AMW composition) and UV-visible spectra. The concentrations of amino acids were extremely variable (3.7-272 microgram/l) throughout the study area but the % composition for each river were broadly similar. The mountain rivers were generally characterized by high ionic contents and the foothills by low ionic contents, while inorganic N and P concentrations were variable throughout the study area, although the molar N:P ratio (average 114) indicated that all the rivers were P limited. There were no discernible regional trends in the concentration of suspended chlorophyll-a, while bacterial concentrations (average 960,000/ml) and microbial activity as C14 acetate incorporation into lipids were generally higher in the foothills province than in the mountain province (average 736 DPM/ml/h). Notably, the cell specific microbial activity was negatively correlated with ammonium concentrations and several amino acids. (Author's abstract)
W90-00594

RESPIRATION OF CHIRONOMUS LARVAE (DIPTERA) FROM DEEP AND SHALLOW WATERS UNDER ENVIRONMENTAL HYPOXIA AND AT DIFFERENT TEMPERATURES.

Cologne Univ. (Germany, F.R.). Lehrstuhl fuer Physiologische Oekologie.
F. Bairlein.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 4, p 523-536, June 1989. 4 fig, 2 tab, 48 ref.

Descriptors: *Limnology, *Aquatic insects, *Midges, *Larvae, *Respiration, Chironomus, Oxygen, Water temperature, Hypoxia.

Oxygen consumption of the aquatic larvae of Chironomus piger, C. thummi, C. anthracinus and C. plumosus were recorded at various temperatures and at various oxygen concentrations. In all species tested, the oxygen uptake increased with increasing experimental temperature. However, the species differed in their respiratory response to increasing temperatures. With declining oxygen concentration in the surrounding water the oxygen consumption of the larvae of various species changed species-specifically and in relation to the experimental temperature. The larvae of the two shallow water species (C. piger and C. thummi) maintained a relatively constant respiration down to low oxygen levels whereas the larvae of the species from deep lakes (C. anthracinus and C. plumosus) reduced their oxygen consumption progressively with declining oxygen concentrations. The species-specific variations in the response to declining oxygen levels are related to the oxygen conditions in their special habitats and to their different resistance to anoxia. (Author's abstract)
W90-00595

STRUCTURE AND DYNAMICS OF THE PHYTOPLANKTON ASSEMBLAGES IN LAKE VOLVI, GREECE: II. PHYTOPLANKTON BIOMASS AND ENVIRONMENTAL FACTORS.

Thessaloniki Univ., Salonika (Greece). Inst. of Botany.
M. Moustaka-Gouni, and I. Tsekos.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 4, p 575-588, June 1989. 8 fig, 1 tab, 21 ref.

Descriptors: *Limnology, *Greece, *Lakes, *Phytoplankton, *Population dynamics, Nitrogen fixation, Species composition, Biomass, Cyanophyta, Diatoms, Cryptophytes, Haptophytes, Chlorophyta, Dinoflagellates, Nutrients, Ammonia nitrogen, Phosphorus, Silica, Lake Volvi.

The seasonal development of phytoplankton biomass in Lake Volvi during the period April 1985-August 1986 exhibited three annual peaks with a tendency towards intermediate pulses in the sequence. The annual maxima ranging from 3.2-13 g/cu m are within the range considered as characteristic of eutrophic waters. The highest phytoplankton biomass developed after a very dry period; the nitrogen fixation by nitrogen-fixing cyanophytes and the release of ammonia-N, P and silica from the anoxic sediment may have been the main sources of nutrient supply in Lake Volvi during the dry, warm period. Cyanophytes, diatoms, cryptophytes, chlorophytes, dinoflagellates and haptophytes, in that order, were the most important constituents of the lake phytoplankton. (Author's abstract)
W90-00596

SEASONAL SUCCESSION OF PLANKTONIC EVENTS IN LAKE AYDAT, FRANCE: A COMPARISON WITH THE PEG MODEL.

Clermont-Ferrand-2 Univ., Aubiere (France).
N. Lair, and H. Ayadi.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 4, p 589-602, June 1989. 5 fig, 28 ref.

Descriptors: *Limnology, *France, *Eutrophic lakes, *Phytoplankton, *Zooplankton, *Succession, Model studies, Biomass, Primary productivity, Transparency, Nitrogen fixation, Nutrients, Silicates, Food chains, Lake Aydat.

The theoretical concepts underlying the Plankton Ecology Group (PEG) model and its causal explanations apply to the seasonal succession of planktonic communities of Lake Aydat, studied in 1984. Observations which illustrate the eutrophic status of this lake could be summarized in 3 major sequences: 3 maxima of phytoplankton biomass (April, July, September) followed by 3 maxima of zooplankton biomass (May, mid-August, October) followed in turn by 3 periods of increased transparency (June, end of August, November). The biomass minimum of phytoplankton in May and the

high primary production characterized a genuine clear water phase: the algal succession was controlled by grazing activities. During the summer, phytoplankton was dominated by Cyanophyta and large size algae which then decreased in August. Nitrogen was the first nutrient to be depleted. As a consequence nitrogen fixers became dominant earlier than in the idealized PEG model. After nitrogen, silicate was the second nutrient that became depleted. A second clear water phase occurred, linked to a high increase in zooplankton and grazing activities. At the beginning of winter, zooplankton organization remained important, and grazing drove again the algal succession that was additionally physically controlled. The detritic food chain seems to be the principal source of energy of zooplankton filter feeders. (Author's abstract)
W90-00597

ASSESSING THE TROPHIC STATUS OF LAKE MIKRI PRESPA, GREECE.
National Centre for Marine Research, Athens (Greece).
T. S. Koussouris, A. C. Diapoulis, and E. T. Balopoulos.
Annales de Limnologie ANLIB3, Vol. 25, No. 1, p 17-24, 1989. 3 fig, 4 tab, 21 ref.

Descriptors: *Lakes, *Hydrologic budget, *Trophic level, *Eutrophication, *Limnology, *Nutrients, *Phosphorus, Mathematical models, Lake Mikri Prespa, Greece.

Lake Mikri Prespa is a shallow water basin characterized by unstable thermal stratification, primary dimictic conditions and clinograde distribution of dissolved oxygen. The nutrient concentrations are high, indicating a trend towards eutrophication. Total P input calculated on the basis of the export coefficient accounting for land-uses and other sources is estimated to be about 15 million kg/yr. A mathematical model is applied to assess the trophic status of the lake in light of development projects recently undertaken in its catchment area. Evaluation of the trophic status reveals that the critical and permissible loading for the lake are 0.07 and 0.03 g/sq m/yr, respectively. Present loading is estimated at 0.27 g/sq m/yr, indicating that the lake is already at a dangerous level. On the basis of the employed O.E.C.D. relationships, the lake is presently classified as mesotrophic to eutrophic. (Author's abstract)
W90-00599

RECENT MODIFICATIONS OF THE AQUATIC VEGETATION IN THE ETANG DU VACCARES (CAMARGUE, FRANCE) IN RELATION WITH THE HUMAN DISTURBANCES (MODIFICATIONS RECENTES DE LA VEGETATION AQUATIQUE DE L'ETANG DU VACCARES (CAMARGUE, FRANCE) LIEES AUX PERTURBATIONS ANTHROPIQUES).
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
A. Vaquer, and P. Heurteaux.
Annales de Limnologie ANLIB3, Vol. 25, No. 1, p 25-38, 1989. 7 fig, 3 tab, 19 ref. English summary.

Descriptors: *Aquatic plants, *Aquatic habitats, *Dikes, *France, *Aquatic environment, *Salinity, Light penetration, Transparency, Bathymetery, Substrates, Wind-driven currents, Climatology, Vaccares, Camargue.

Since the construction of the dikes in the last century, the Vaccares, the main waterbody on the Reserve Nationale de Camargue, has been cut off from the natural influences of the sea and the Rhone. Since then, apart from the uncontrolled action of climatic conditions (rainfall and evaporation), water and salt balance have been basically controlled activities, whereas salinity has been subjected to fundamental changes. Prior to 1950, it was very saline (up to 100 g/l); between 1950-79 mean salinity dropped to 6 g/l; from 1980 the salinity increased to values close to sea water. Since 1950 these changes in salinity have led to striking changes in the aquatic plant community. Salinity changes over this period, bathymetry, substratum composition and optical quality of water can be used to interpret the evolution of the vegetation. During the desalination period the halophytic vegetation, including Potamogeton pectinatus and Ruppia maritima, tended to a freshwater type with Myriophyllum spicatum and Phragmites communis expanding whereas R. maritima disappeared completely. As soon as 1980 as a consequence of the increase in salinity all these species disappeared and two years later they had been replaced by Zostera noltii. Salinity changes indirectly acted on water quality, especially its clarity. During the desalination period large amounts of muddy deposit on the substratrum were deflocculated and maintained in suspension by the turbulent action of very frequent winds. In 1978, the calculated compensation limit would have reached a depth of 0.6 m. Then the quantity of light transmitted was probably a limiting factor to the development of aquatic plant communities. Increasing salinity favored flocculation of total suspended matter. The better transmission of light through the water would explain a larger extension of the aquatic plant community during the last period. The future of this vegetation is closely connected with the variations in salinity which depend in turn on climatic conditions and human activity. (Author's abstract)
W90-00600

ENVIRONMENTAL VARIABLES AND THEIR EFFECT ON PHOTOSYNTHESIS OF AQUATIC COMMUNITIES.
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Sand-Jensen.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 5-25, July 1989. 7 fig, 73 ref.

Descriptors: *Limnology, *Aquatic plants, *Macrophytes, *Phytoplankton, *Algae, *Plant physiology, *Photosynthesis, *Aquatic habitats, Littoral environment, Pelagic environment, Respiration, Dissolved inorganic carbon, Carbon dioxide, Oxygen, Reviews, Light penetration.

Environmental variables affect both photosynthetic pigments and enzymes and instantaneous photosynthetic rates of aquatic plants. Environmental conditions have been better described for pelagic phytoplankton than for littoral communities of macrophytes and attached microalgae which, furthermore, live in a structurally more complex and dynamic environment. Phytoplankton in well-mixed surface waters is circulated in a light gradient over a long distance, and this makes precise light adaptation difficult. Light is rapidly attenuated with depth in dense communities of macrophytes and attached algae, but the light climate is nevertheless more predictable and light adaptation simpler because of the fixed vertical position of a macrophyte leaf or an attached microalga. Dense communities of macrophytes and attached algae have high rates of photosynthesis in light and respiration in the dark per unit volume of the medium they live in. Because of reduced exchange of dissolved metabolites with the more uniform pelagial waters, they experience marked variations in dissolved inorganic carbon (DIC), CO2 and O2 with depth and light and darkness. The simultaneous depletion of DIC and CO2 and build-up of O2 which occur in the light within the diffusive boundary layers that surround leaf surfaces and attached algal communities call for particularly efficient mechanisms to assimilate inorganic carbon. (Author's abstract)
W90-00601

PHOTOSYNTHETIC STRATEGIES AND PRODUCTIVITY IN AQUATIC SYSTEMS.
Wisconsin Univ., Madison. Dept. of Botany.
H. L. Boston, M. S. Adams, and J. D. Madsen.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 27-57, July 1989. 5 tab, 190 ref.

Descriptors: *Limnology, *Aquatic plants, *Macrophytes, *Primary productivity, *Plant physiology, *Photosynthesis, *Aquatic habitats, Carbon dioxide, Bicarbonates, Reviews, Species composition.

The primary productivity in aquatic habitats is largely dependent on the constraints on both species composition and photosynthetic rates. For macrophytes, major adaptations for life in water are associated with constraints on photosynthesis. Adaptations to increase carbon fixation, e.g., include: (1) mechanisms to concentrate inorganic carbon for photosynthesis, e.g. C4-like and CAM carbon fixation, and the ability to remove HCO3(-) from the water; (2) the use of alternate sources of carbon, e.g. sediment CO2; (3) adaptation for net photosynthesis at low-light intensities; (4) morphological adaptation to increase inorganic carbon or mineral acquisition. Such characteristics are evaluated at the species or community level to provide insight into the ways in which adaptations for photosynthesis are integrated into a plant's strategy or suite of adaptations to constraints on growth or production. In nutrient-poor, softwater habitats, for example, the common rooted plants have adaptations that allow tolerance of low rates of nutrient delivery to the plant and the conservation of captured resources. These adaptations are compatible with the low rates of nutrient availability, although the slow growth results in low annual primary production. In habitats with generally higher levels of inorganic carbon and other nutrients, where competition among plants limits the availability of these resources, species have adaptations that allow rapid growth and biomass accumulation. Here, species are more likely to be able to remove HCO3(-) from the water for photosynthesis efficiently, and may have other carbon-concentrating mechanisms that allow rapid photosynthesis. These considerations serve as one possible framework for relating adaptations for photosynthesis to plant growth characteristics and the primary productivity of aquatic systems. (Author's abstract)
W90-00602

BICARBONATE UTILIZATION: FUNCTION AND MECHANISM.
Groningen Rijksuniversiteit (Netherlands). Dept. of Plant Physiology.
H. B. A. Prins, and J. T. M. Elzenga.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 59-83, July 1989. 3 fig, 1 tab, 116 ref.

Descriptors: *Aquatic plants, *Plant physiology, *Photosynthesis, *Limnology, *Bicarbonates, Carbon dioxide, Hydrogen ion concentration, Enzymes, Reviews.

The occurrence, ecological significance and physiological mechanism of HCO3(-) utilization by aquatic photosynthetic organisms are reviewed. Following a short description of the CO2 water system, the significance of the unstirred layer and the slow diffusion rate of CO2 in water is discussed. Three experimental procedures establish the use of HCO3(-): establishing the relationship between pH and rate of carbon assimilation; the kinetic-reaction approach, which uses the slow equilibrium between CO2 and HCO3(-) in water; the difference in discrimination between C12 and C13 during CO2 and HCO3(-) assimilation. The ability to use HCO3(-) occurs in many different groups of aquatic photosynthetic organisms, with the notable exception of Bryophytes and Pteridophytes, and is related to growth conditions. Polarity, i.e. the spatial separation of HCO3(-) influx and resulting OH(-) efflux, is observed in higher plant species and Characeae that assimilate HCO3(-). These polar leaves or banded Characean cells are often used to study the mechanism. Three mechanisms for HCO3(-) assimilation apparently exist: H(+)-HCO3(-) symport, external acidification of HCO3(-) into CO2 and an increased rate of conversion of HCO3(-) into CO2 by the action of carbonic anhydrase. The role of transfer cells or plasmalemmasomes, often observed in HCO3(-) assimilating leaves, is still unclear. Their role may be to create sufficient space for membrane-bound enzyme systems by increasing the membrane surface area or to confine an extracellular space with a low pH. The ecological significance of photosynthetic HCO3(-) utilization seems to be that it compensates for slow supply of CO2 by diffusion and/or suppresses photorespiration by creating a high intracellular CO2 concentration. (Author's abstract)
W90-00603

FUNCTION OF CARBONIC ANHYDRASE IN AQUATIC PHOTOSYNTHESIS.
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
M. Tsuzuki, and S. Miyachi.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 85-104, July 1989. 3 fig, 2 tab, 117 ref. Japanese Ministry of Agriculture, Forestry and Fisheries grant GEP60-II-1-9.

Descriptors: *Aquatic plants, *Algae, *Cyanophyta, *Chlamydomonas, *Limnology, *Chlorophyta, *Plant physiology, *Photosynthesis, *Enzymes, Carbonic anhydrase, Carbon dioxide, Reviews.

There is little information on the molecular properties and reaction characteristics of carbonic anhydrase (CA) in aquatic plants. The intracellular location and molecular characteristics of CA vary; some species have CA both inside the cells and on their surface, while others have only an internal enzyme. Most CA in Chlamydomonas reinhardtii is soluble, while about 80% is insoluble in Chlorella vulgaris. The insoluble CA from C. vulgaris is heat-stable, while the soluble CA from C. reinhardtii is heat labile. Chlamydomonas CA does not form a precipitate against antibody of spinach CA, or vice versa. Cells grown under ordinary air (low-CO2 cells) show higher activity of CA than those grown under high CO2 conditions. Synthesis of the CA starts when high-CO2 cells are transferred into low CO2 conditions, while synthesis stops when low-CO2 cells are transferred to high-CO2. In aquatic angiosperms such as Myriophyllum, CA is induced under summer-like conditions (high temperature and long day length). CA on the cell surface of Chlamydomonas responds to changes in the CO2 concentration used for growth in a similar manner to the internal CA. However, the external CA in some species of Chlorella shows comparable activities between low- and high-CO2 cells. Since the apparent Km(CO2) for photosynthesis in low-CO2 cells in always lower than that in high-CO2 cells, CA inside the cells seems to lay a more important role in decreasing the apparent Km(CO2) for photosynthesis than the external enzyme. The CA on the cell surface is important for the conversion of HCO3(-) to CO2. The converted CO2 is then absorbed by green algae. In this respect, the CA may play a role in HCO3(-) utilization for those species where HCO3(-) is the dominant form assimilated. Various microalgae and cyanobacteria can accumulate inorganic carbon into low-CO2 cells during photosynthesis, to an extent far in excess of its concentration in the suspending medium. The nature and intracellular location of the accumulating system of inorganic carbon remains to be determined. (Author's abstract)
W90-00604

PHOTOSYNTHESIS OF SALT MARSH SPECIES.
Smithsonian Environmental Research Center, Edgewater, MD.
B. G. Drake.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 167-180, July 1989. 1 tab, 68 ref.

Descriptors: *Salt marshes, *Aquatic plants, *Plant physiology, *Wetlands, *Photosynthesis, Carbon dioxide, Water stress, Salt stress, Salinity, Nutrients, Reviews.

The salt marsh environment is severe. Stressful edaphic factors include high and variable salinity, a strongly reducing environment, anoxia, and toxic compounds such as hydrogen sulfide. Mechanisms which adapt endemic species to these conditions include osmoregulation, anaerobic metabolism, aerenchyma, xeromorphism, tolerance of salt and water stress, and high water and nitrogen use efficiency. Species having the C3 and C4 photosynthetic pathway are common in salt marshes. Succulents are also present although none are known to operate the crassulacean acid metabolism. Photosynthetic rates measured in situ are relatively low, but high rates have been measured in laboratory-grown plants and this suggests that some or all of the above mentioned factors control photosynthesis in the field. Nutrient status may regulate the photosynthetic apparatus through effects on the metabolic components of carbon reduction and on the capacity of the plant to control water balance. Field and laboratory studies show that light and CO2 saturated photosynthetic capacity decreases and, in C4 species, the CO2 compensation point increases under nitrogen limiting conditions. Water stress regulates growth and photosynthesis. Photosynthetic responses to increasing salinity are highly species specific, but within species the responses depend on light, temperature and nutrient status during growth. Both the stomatal conductance of CO2 and the metabolic determinants of photosynthesis are affected by salinity but the available data suggest that the primary effect of salinity is on the metabolic components. (Author's abstract)
W90-00605

PHOTOSYNTHESIS AND PHOTORESPIRATION IN FRESHWATER GREEN ALGAE.
Iowa State Univ., Ames. Dept. of Botany.
M. H. Spalding.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 181-209, July 1989. 1 fig, 1 tab, 159 ref.

Descriptors: *Limnology, *Aquatic plants, *Photosynthesis, *Respiration, *Plant physiology, *Chlorophyta, Inorganic carbon, Carbon dioxide, Bicarbonates, Reviews.

Photosynthesis in freshwater green algae has been studied for years, but interest has increased in the last decade, largely owing to the demonstration that unicellular algae avoid photorespiration through the use of a CO2-concentrating system. Biochemically, photosynthesis and photorespiration in the green algae are similar to C3 higher plants. There is a difference, however, in the mechanism of inorganic carbon uptake prior to the actual fixation of CO2. The unicellular green algae can accumulate inorganic carbon through active transport, although it is not clear whether CO2 or HCO3(-) is transported, nor is it clear across which membrane the transport occurs. Some unicellular green algae can use HCO3(-) as a source of inorganic carbon, but it is thought that the HCO3(-) is only used indirectly, after conversion to CO2. The active transport of inorganic carbon results in a substantial increase in the intracellular CO2 concentration, which inhibits ribulose bisphosphate oxygenase activity, suppressing photorespiration. This inorganic carbon transport is also inducible, apparently being expressed only when inorganic carbon concentrations are low or inorganic carbon is limiting for growth. The filamentous green algae, represented by charophytes, are apparently able to use HCO3(-) as a source of inorganic carbon, although there is controversy over whether the HCO3(-) is directly or indirectly transported into the cells. Unlike the situation in microalgae, there is no evidence as yet that the charophytes concentrate CO2 intracellularly. The ecological significance of the inorganic carbon acquisition systems of the green algae is not completely clear. Although it has been suggested that inorganic carbon is rarely limiting in natural systems, the argument can be made that it might well be limiting in the absence of these specialized inorganic carbon uptake systems, even though inorganic carbon might not be limiting in their presence. (Author's abstract)
W90-00606

PHOTOSYNTHETIC CARBON ASSIMILATION AND THE SUPPRESSION OF PHOTORESPIRATION IN THE CYANOBACTERIA.
York Univ., Toronto (Ontario). Dept. of Biology.
B. Colman.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 211-231, July 1989. 92 ref.

Descriptors: *Limnology, *Photosynthesis, *Respiration, *Plant physiology, *Cyanophyta, Carbon dioxide, Oxygen, Enzymes, Bicarbonates, Reviews.

The physiology and biochemistry of photosynthetic carbon assimilation in cyanobacteria is discussed in relation to its apparent suppression of photorespiration in these organisms. Experimental evidence indicates that CO2 fixation in cyanobacteria is mediated by the C3 pathway and although C4 acids are among the initial products of photosynthesis, these organisms do not have the enzymatic capacity for he operation of a C4 pathway. C4 acid synthesis appears to be required for the biosynthesis of amino acids, necessitated by the absence of a complete tricarboxylic acid cycle in these organisms. The ribulose-1,5-bisphosphate carboxylase isolated from cyanobacteria has a low CO2 affinity and is markedly inhibited by O2, but it may be protected from O2 inhibition by sequestration in carboxysomes. There is no evidence that glycolate, the photo-respiratory substrate, is produced in air-grown cyanobacteria, and a glycolate oxidation pathway, similar to that in C3 plants, appears to be lacking in these organisms. Excretion of glycolate by cyanobacteria is an artifact of growth on high CO2 concentrations, or of experimental manipulation, and is not a normal consequence of photosynthesis. Cyanobacterial photosynthesis is not inhibited by O2 and the cells have a high apparent affinity for CO2 and very low CO2 compensation points. No photorespiratory CO2 release has been detected in cyanobacterial cells maintained at concentrations above the CO2 compensation point. Cyanobacteria take up extracellular HCO3(-) by a sodium and energy-dependent active transport mechanism which results in the intracellular accumulation of inorganic carbon 500-1000-fold the concentration outside the cells. There is also some evidence of a small component of active CO2 uptake by cyanobacterial cells. The active intracellular accumulation of inorganic carbon may be sufficient to inhibit ribulose-1,5-bisphosphate oxygenase activity in cyanobacterial cells and therefore to suppress photorespiration. The evidence for HCO3(-) uptake by cyanobacteria in nature is sparse. Laboratory studies suggest that cyanobacteria growing under conditions of dissolved inorganic carbon depletion and high O2 tension have the ability to take up HCO3(-) and the photorespiration is suppressed under these conditions. (Author's abstract)
W90-00607

PLASTICITY IN THE PHOTOSYNTHETIC CARBON METABOLISM OF SUBMERSED AQUATIC MACROPHYTES.
Florida Univ., Gainesville. Dept. of Botany.
G. Bowes, and M. E. Salvucci.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 233-266, July 1989. 151 ref. USDA grant 82-CRCR-1-1147.

Descriptors: *Aquatic plants, *Submerged plants, *Plant physiology, *Limnology, *Photosynthesis, Dissolved inorganic carbon, Light, Temperature, Hydrogen ion concentration, Oxygen, Nutrients, Bicarbonates, Enzymes, Reviews.

The physiological and biochemical adaptations that enable submersed aquatic macrophytes to manage constraints associated with photosynthesis under water are reviewed. The constrains are dissolved inorganic carbon (DIC), light and temperature, although pH, O2 and mineral nutrients may be factors. Submersed aquatic macrophytes are characterized by low photosynthetic rates, with low light requirements and very high apparent Km(CO2/HCO3(-)) values. These features are mainly caused by low DIC diffusion rates. High pH (10) may limit photosynthesis by decreasing free CO2. Temperature responses vary, partly owing to growth adaptations, with photosynthesis reported under ice and at 35 C. Even though the photosynthetic carbon reduction and photorespiratory carbon oxidation cycles operate in submersed aquatic macrophytes, they possess mechanisms which preclude classifying them with C3 or C4 photosynthesis. These include: utilization of HCO3(-), C4 acids, and sediment CO2. A major feature of submersed aquatic macrophytes is their plasticity, which is seen in variable CO2 compensation points that indicate the photorespiratory (PR) state. Unlike unicellular phototrophs, submersed aquatic macrophytes usually exist in an O2-sensitive, high PR (C3-like) state, but under daytime stress conditions of high light, temperature, O2, and low CO2 a low-PR state is induced. The active uptake of HCO3(-) and/or fixation initially by

phosphoenolpyruvate carboxylase in a C4-like system, but without Kranz anatomy, concentrates CO2 internally. The result is a low-PR state, with reduced O2 inhibition of ribulose bisphosphate-oxygenase. Not all species use HCO3(-) effectively. Some fix CO2 at night in a CAM-like system, while other rosette forms take sediment CO2, via roots, and pipe it in lacunae to the leaves. These mechanisms all conserve carbon and improve DIC availability. (Author's abstract)
W90-00608

PHOTOSYNTHESIS AND PHOTORESPIRATION IN FRESHWATER ORGANISMS: AMPHIBIOUS PLANTS.
Saint Andrews Univ. (Scotland). Dept. of Biology and Preclinical Medicine.
S. C. Maberly, and D. H. N. Spence.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 267-286, July 1989. 5 tab, 87 ref.

Descriptors: *Aquatic plants, *Plant physiology, *Photosynthesis, *Limnology, *Respiration, Carbon dioxide, Oxygen, Bicarbonates, Temperature, Amphibious plant, Enzymes, Light, Reviews.

Amphibious macrophytes are remarkable for their ability to photosynthesize in air and water, since these two media are very different. Specifically, water has a higher water potential, greater thermal stability, but reduced availability of light, CO2 and O2 than air. In heterophyllous amphibious plants, production of an appropriate leaf form is triggered by water potential, temperature, photoperiod, ratio of red to far-red light, or CO2 concentration in some species. These effects may be mediated by endogenous growth regulators. High concentration of CO2 are necessary to saturate photosynthesis of submerged shoots of amphibious species underwater, largely because of boundary-layer resistance. The low rate of CO2 supply underwater is reflected in low activities of carboxylating and other enzymes involved in photosynthesis in submerged shoots. Any limitation of photosynthesis by CO2 is rarely overcome by HCO3(-) use; rather, the aerial portion may allow access to an environment with greater availability of CO2. Alternatively, submerged-CAM found in amphibious species such as Isoetes howellii may reduce CO2 limitation of photosynthesis by exploiting the higher CO2 concentration often found at night. Photorespiration is present in submerged and aerial shoots, but incubation underwater at high temperature (30 C) and long days (14 h) reduces photorespiration in both shoot types in Myriophyllum brasiliense and Proserpinaca palustris. Higher relative activities of phosphoenolpyruvate carboxylase in submerged compared with emerged shoots of some amphibious species may be a response which reduces photorespiration. Submerged shoots require less light to saturate photosynthesis and have generally lower light compensation points at air levels of CO2. It is unclear whether or not this is partly caused by the interacting effect of CO2. Amphibious macrophytes are poorly understood, and future work should distinguish between the effects of air and water, environmental pretreatment, and linkage to changes in leaf form when photosynthetic and photorespiratory responses of submerged and aerial shoots are compared. (Author's abstract)
W90-00609

PHOTOSYNTHESIS AND PHOTORESPIRATION IN FRESHWATER EMERGENT AND FLOATING PLANTS.
Louisiana State Univ., Baton Rouge. Dept. of Botany.
D. J. Longstreth.
Aquatic Botany AQBODS, Vol. 34, No. 1-3, p 287-299, July 1989. 1 tab, 36 ref.

Descriptors: *Aquatic plants, *Floating plants, *Plant physiology, *Limnoloyg, *Photosynthesis, *Photorespiration, Carbon dioxide, Leaves, Temperature, Light, Reviews.

Little is known about photosynthesis and photorespiration in freshwater emergent and floating species even though these plants can be very effective producers of biomass. Species for which carbon fixation has been examined in any detail are generally C3, although more studies are needed to draw firm conclusions. There appear to be no unique biochemical adaptations in the carbon fixation pathways of these species. There may be unusually high CO2 concentrations in the leaf intercellular spaces of at least some of these species. Gas movement from roots or rhizomes to leaves through spaces or aerenchyma produces these high concentrations. As a consequence, photosynthetic rates in situ may be higher than expected for C3 species because ambient CO2 concentrations are normally limiting to photosynthesis. Most emergent species have a relatively vertical leaf orientation and a high leaf-area index (leaf area per unit substrate surface area), characteristics that should optimize canopy carbon fixation. While hypoxia in standing water can severely affect plant physiology, species adapted to these conditions have a relatively unlimited water supply. Other environmental conditions such as temperature and photon flux density are generally favorable for carbon fixation in many of these wet habitats. Therefore, high productivity of at least some of these species may be caused by supplementation of atmospheric CO2 by substrate sources, optimal canopy architecture, and growth under favorable environmental conditions. (Author's abstract)
W90-00610

POPULATION DYNAMICS OF UNEXPLOITED LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) IN ONE EXPERIMENTALLY FERTILIZED LAKE AND THREE EXPLOITED LAKES.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 8I.
W90-00611

EFFECTS OF REGULATION ON THE ECOLOGY OF THE LITTORAL ZONE AND THE FEEDING OF WHITEFISH, COREGONUS SPP., IN LAKES IN NORTHERN FINLAND.
Valtion Teknillinen Tutkimuskeskus, Oulu (Finland). Building Lab.
P. Tikkanen, T. Niva, T. Yrjana, K. Kuusela, and S. Hellsten.
Finnish Fisheries Research FNFRAK, Vol. 1988, No. 9, p 457-465, 1988. 9 fig, 2 tab, 11 ref.

Descriptors: *Dam effects, *Limnology, *Lake management, *Littoral zone, *Whitefish, *Fish food organisms, *Fish diets, Feeding rates, Zooplankton, Macroinvertebrates, Biomass, Population density, Lake Lentua, Lake Ontojarvi, Finland.

The basis for estimating the effects of regulation was a comparison of the macrozoobenthos in geomorphologically similar littoral zones and habitats in a regulated lake, Lake Ontojarvi, and a lake in its natural state, Lake Lentua. In addition, the stomach contents of whitefish were analyzed by dividing the estimated stomach fullness value (max. 34) between the different food types. The diet overlap method was also employed. The abundance and biomass of macrozoobenthos were higher in the non-regulated lake by a factor of 2 to 3. The difference was less marked on sandy bottoms than on rocky bottoms. Chironomid larvae dominated the macrobenthic communities in the regulated lake in terms of both abundance and mass. The whitefish used benthic, aerial and planktonic food consistently in both lakes. No connection between the gill raker number (average 46.5) and the food type was detected in either of the lakes. The proportion of planktonic food ingested was higher in the regulated lake, especially in late summer. Benthic animals were more important at all times in the non-regulated lake. The fullness values of the whitefish stomachs were greatest in spring in the non-regulated lake, the stomachs of whitefish in the regulated lake being significantly emptier at that time. The fullness of the stomachs in the whitefish of the regulated lake increased towards the end of the summer, mostly due to increased utilization of planktonic Cyclopoida. (Author's abstract)
W90-00612

MODELLING THE IMPACTS OF LAKE REGULATION ON WHITEFISH STOCKS.
National Board of Waters, Helsinki (Finland).
T. Frisk, K. Salojarvi, and M. Virtanen.
Finnish Fisheries Research FNFRAK, Vol. 1988, No. 9, p 467-475, 1988. 15 fig, 14 ref.

Descriptors: *Dam effects, *Lake regulation, *Lake morphology, *Whitefish, *Fish stocking, *Population dynamics, *Fish food, *Fish diets, Population density, Growth, Respiration, Fish eggs, Spawning, Mathematical models, Lake Oulujarvi, Finland, Model studies.

A numerical model for simulating the effects of lake regulation on fish stocks was developed. It is based on assumed functional relationships and specified causal connections between a great number of factors. These include dependence of: (1) lake volume and bottom area (of each type at each depth) on water level, (2) fish densities (utilizing each food habitat) on the food available, (3) the food consumed on the densities of active fish, (4) the food biomass (of each group at each depth) on their growth, respiration and predation, (5) fish weight on the food eaten and fish density (growth and respiration), (6) spawning areas on water level during spawning, (7) egg numbers on the spawning stock, (8) egg mortality on egg densities and water level during the incubation period, and (9) mortality rates (including fishing) on fish weight. The model includes non-linear effects and several feedbacks. The stock size and catch of each species and age are calculated using equations derived from a multi-series population analysis using weight-dependent mortality rates. The model was applied to a preliminary study of the two species forming the whitefish stock of Lake Oulujarvi in Northern Finland. (Author's abstract)
W90-00613

PROPOSED BIOLOGICAL MANAGEMENT OF MYSIS RELICTA IN COLORADO LAKES AND RESERVOIRS.
Colorado Div. of Wildlife, Grand Junction.
For primary bibliographic entry see Field 8I.
W90-00614

DISTRIBUTION AND ABUNDANCE OF FISHES ASSOCIATED WITH SUBMERSED AQUATIC PLANTS IN THE POTOMAC RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
K. J. Killgore, R. P. Morgan, and N. B. Rybicki.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 101-111, Winter 1989. 2 fig, 7 tab, 27 ref.

Descriptors: *Aquatic plants, *Fish populations, *Submerged plants, *Fish management, Species composition, Menhaden, Herring, Bullhead, Killifish, Pumpkinhead, Bass, Perch, Anchovy, Silverside, Seasonal variation, Potomac River.

The distribution and abundance of fishes in submersed aquatic plants of three relative densities (no plants, intermediate plant density, high plant density) were estimated in the tidal Potomac River near Alexandria, Virginia. Fish were sampled with a boat-mounted electroshocker at night in May (when plants were emerging), August (peak plant densities), and November (plant senescence) of 1986. Mean densities of all plants ranged from 9-33 g/sq m (dry-wt) in May, and 400 to >1000 g/sq m in August and November. Hydrilla verticillata was usually the dominant aquatic plant. In May, overall mean fish abundance was highest in areas of high plant density (36 fish/5 min shocking), whereas in August and November fish abundance was highest in areas of intermediate plant densities (100 and 62 fish/5 min electroshocking, respectively). Areas without plants contained a relatively high number of filter-feeding fishes, including Atlantic menhaden Brevoortia tyrannus and blueback herring Alosa aestivalis. The fish assemblage in the vegetated sites comprised mainly brown bullhead Ictalurus nebulosus, banded killifish Fundulus diaphanus pumpkinseed Lopomis gibbosus, largemouth bass Micropterus salmoides, and yellow perch Perca flavescens. The bay anchovy Anchoa mitchilli, white perch Morone americana, and

inland silverside Menidia beryllina were distributed throughout all three sites during the study. Fish also were sampled with pop nets in aquatic plants and with seines between shore and the plant beds. More than 5 times more fish (9.8/sq m) were collected with pop nets in areas with intermediate plant density, where there were several codominant plant species, than in areas with dense hydrilla (1.8 fish/sq m)/ Shore-zone fish densities estimated with seine hauls were higher in areas adjacent to dense hydrilla beds (9 fish/sq m) than in areas with no plants (1.5/sq m) or near intermediate plant densities (3.3/sq m), but the number of fish species was lowest near hydrilla. (Author's abstract)
W90-00619

SCALE-DEPENDENT DYNAMICS: ZOOPLANKTON AND THE STABILITY OF FRESHWATER FOOD WEBS.
Michigan Univ., Ann Arbor. Dept. of Biology.
W. C. Kerfoot, and D. L. DeAngelis.
Trends in Ecology and Evolution TREEEQ, Vol. 4, No. 6, p 167-171, June 1989. 5 fig, 1 tab, 39 ref. NSF grants DEB 80-04654, DEB 82-07007, and BSR-8400244, NSF Ecosystem Studies Program agreement 40-689-78, U.S. Department of Energy contract DE-AC05-840R21400.

Descriptors: *Food chains, *Ecosystems, *Zooplankton, *Limnology, *Fish populations, *Population dynamics, Phytoplankton, Food webs.

Recent efforts to clarify how freshwater food web interactions differ from food chain interactions have emphasized the various, often subtle, repercussions of top predators on communities. Predators can modify community structure not only through directly imposed death rates, but also through direct and indirect effects on prey interactions, behavior, life-styles and morphology (e.g. induction of defenses). In some cases, the effects influence ecosystem properties (material fluxes, turnover rates and primary production). Attempts to trace food web impacts in enclosure and lake studies have revealed important time-dependent system properties. Severe resource limitation of fast variables (phytoplankton and small zooplankton) stabilizes lower trophic levels, whereas the potentially destabilizing effects of fish population oscillations are long compared to the growing season and subject to year-to-year climatic vagaries. The time scale dependent approach is important because it emphasizes how local (transient) solutions may be more ecologically relevant to stability calculations than overall (global) solutions. (Author's abstract)
W90-00624

SIMULATION OF WIND-INDUCED WATER CURRENTS.
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
I. K. Tsanis.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1113-1134, August 1989. 15 fig, 1 tab, 33 ref, append. Natural Sciences and Engineering Research Council of Canada--A-1541.

Descriptors: *Air-water interfaces, *Wind-driven currents, *Wind velocity, *Wave velocity, *Water currents, Eddies, Turbulent flow, Velocity distribution, Hydraulic roughness, Laboratory equipment, Dimensional analysis, Simulation analysis, Viscosity.

Theoretical and conventional experimental approaches to studies of wind-induced water currents are reviewed and a new method is introduced for simulating these motions in the laboratory. Mean velocity profiles obtained in conventional air-water systems, when plotted in terms of the coordinates of the 'smooth inner' law of velocity distribution, relegate all of the experiments into the region of transitional roughness. The shortcomings of laboratory air-water systems such as uncontrollable surface roughness and three-dimensionality of flow are overcome with a novel experimental approach in which the actual water body is represented by the air volume contained inside a moving box, and the surface of a stationary wall constitutes the actual air-water interface. Mean velocity profiles obtained with this apparatus are used to verify an analytical solution based on the parabolic distribution of the eddy viscosity. (Author's abstract)
W90-00632

ATMOSPHERIC DEPOSITION OF PHOSPHORUS AND NITROGEN IN CENTRAL ALBERTA WITH EMPHASIS ON NARROW LAKE.
Alberta Univ., Edmonton. Dept. of Zoology.
R. D. Shaw, A. M. Trimbee, A. Minty, H. Fricker, and E. E. Prepas.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 119-134, January 1989. 5 fig, 4 tab, 29 ref.

Descriptors: *Water pollution sources, *Atmospheric water, *Precipitation, *Phosphorus, *Nitrogen, *Nutrients, Lake basins, Surface runoff, Excess rainfall, Drainage water, Epilimnion, Seasonal variation, Deposition, Iced lakes, Canada.

Atmospheric deposition can be a significant source of phosphorus (P) and nitrogen (N) to lakes. The high loading rates far surpass the permissible loads for these nutrients to many lakes. Data was collected from 1983 to 1986 at Narrow Lake, Alberta, Canada, to evaluate atmospheric deposition of P and N to lakes in central Alberta. Average rates of atmospheric deposition of total P (TP) and total N (TN) to Narrow Lake were 20 and 424 milligrams per square meter per year, respectively, between 1983-1986. There were no significant differences in deposition rates between sites on Narrow Lake, on the lake shore, and on land 18 kilometers away. Deposition of TP, but not TN, followed a distinct pattern during the open-water season; TP was highest just after ice-off (May) and decreased throughout the remainder of the open-water season. Deposition during the winter accounted for only 4 and 12% of the annual TP and TN loads, respectively. Dry fallout contributed 50 and 33% of atmospheric deposition of TP and TN, respectively. In both dry and wet fallout, dissolved P and organic N were the predominant fractions of TP and TN, respectively. During July 1986, unusually heavy rainfalls caused an increase in TP, but not TN, concentrations in the epilimnion of Narrow Lake. Wet fallout accounted for only 9% of the observed increase of epilimnetic TP; the rest was from surface runoff from the drainage basin. (Author's abstract)
W90-00645

APPROXIMATE DYNAMIC LAKE PHOSPHORUS BUDGET MODELS.
Noranda, Inc., Denver, CO. Environmental Services.
For primary bibliographic entry see Field 5C.
W90-00662

WATER STORAGE CAPACITY OF WETLAND USED FOR WASTEWATER TREATMENT.
George Mason Univ., Fairfax, VA. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W90-00663

PERFORMANCE OF IN SITU MICROCOSMS COMPARED TO ACTUAL RESERVOIR BEHAVIOR.
Nevada Univ. System, Las Vegas. Water Resources Center.
R. H. French, and R. J. Watts.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 835-849, August 1989. 9 fig, 5 tab, 13 ref, append. U.S. Environmental Protection Agency Assistance agreement R811124-02-0.

Descriptors: *Limnology, *Model studies, *Reservoirs, *Trophic level, *Water temperature, *Nutrients, Chlorophyll a, Light penetration, Dissolved oxygen, Performance evaluation.

The behavior of replicate control microcosms in three experiments was compared to each other and to the behavior of the reservoir in which the experiments were conducted (Lahontan Reservoir, Nevada) during the summers of 1982 and 1986. In 1982 the response of the reservoir phytoplankton community to additions of the algal nutrients nitrogen and phosphorus and the phosphorus precipitant aluminum sulfate (alum) were studied. The microcosms consisted of polyethylene tubes of various diameters and lengths. The results obtained from these experiments were flawed because nitrate was leached from a component of the microcosms. In the second and third experiments (summer 1986), the effect of various nutrient and chemical additions on microcosm water was assessed. The microcosms accurately and consistently simulated the vertical profiles of temperature in the reservoir as well as the concentration of nitrogen and phosphorus, chlorophyll a, and light penetration. In all three experiments, the microcosms were unable to simulate accurately the reservoir concentrations of dissolved oxygen. The replicate microcosms did perform as replicates. (Geiger-PTT)
W90-00664

PLANT PRODUCTION, DECOMPOSITION, AND CARBON EFFLUX IN A SUBARCTIC PATTERNED FEN.
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
Arctic and Alpine Research ATLPAV, Vol. 21, No. 2, p 156-162, May 1989, 3 fig, 3 tab, 32 ref.

Descriptors: *Wetlands, *Fens, *Limnology, *Primary productivity, *Decomposition, *Plant growth, *Biomass, Gas flux, Bogs, Subarctic zone, Carbon, Flarks, Canada, Methane, Carbon dioxide.

Measurements of plant biomass and primary productivity, plant-tissue decomposition, and gas flux were made at sites representing strings, flarks, and pools in a strongly patterned fen near Schefferville, northern Quebec. Biomass and production were strongly related to the position of the water table, with biomass ranging from an average of 190 g/sq m on the strings to 7 g/sq m in the pools. Scirpus cespitosus shoots and Chamaedaphne calyculata leaves decomposed slowly at both string and pool sites, losing 25 to 35% of their mass after 3 years. In contrast, Menyanthes trifoliata, characteristic of the deeper pools, lost 80% of its mass after 3 years. Carbon dioxide dominated the gas flux at the string site, but there were significant fluxes of methane at the flark and pool sites (7-8 g/sq m/year). A carbon budget, based on production and gas flux, suggested that the string site gained carbon at about 40 g/sq m per year whereas the flark site (with the water surface very close to the peat surface) lost about 15 g/sq m/year and the pool site (with the water surface about 25 cm above the peat site) showed a very small loss (about 2 g/sq m/year). The results show that differential rates of plant production, combined with differences in the rates of plant tissue decomposition and methane efflux, contribute to the expansion of the flark/pool morphology at the present time. (Author's abstract)
W90-00675

SPATIAL VARIATION IN FISH COMMUNITIES IN TWO SOUTH-WESTERN AUSTRALIAN RIVER SYSTEMS.
Western Australia Univ., Nedlands. Dept. of Zoology.
B. J. Pusey, A. W. Storey, P. W. Davies, and D. H. D. Edward.
Journal of the Royal Society of Western Australia JRSUAU, Vol. 71, No. 2-3, p 69-75, 1989. 3 fig, 17 ref.

Descriptors: *Fish populations, *Limnology, *Ecology, *Spatial distribution, *Rivers, *Australia, Streamflow, Canning River, North Dandalup River, Habitats, Minnow.

The fish fauna of two river systems, the Canning and North Dandalup catchments, were sampled every three months over an eighteen month period. Similar number of species and individuals were recorded from both systems. The majority of headwater streams were temporary, predominantly colonized by the native minnow, Galaxias occiden-

talis. Physical obstruction to the seasonal migration of this species by both natural and manmade barriers was evident. At lowland sites an exotic, Gambusia affinis, was dominant in the Canning River, and was the second most abundant species in the North Dandalup River. The distribution of G. affinis seems to be dependent on habitat requirements, and adaptation to stream disturbances. (Author's abstract)
W90-00692

SUCCESSIONAL CHANGES IN HABITAT CAUSED BY SEDIMENTATION IN NAVIGATION POOLS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W90-00697

EFFECT OF LOW WATER LEVELS ON THE WATER QUALITY OF LAKE BIWA.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
A. Kurata.
Hydrobiologia HYDRB8, Vol. 176/17, p 29-38, July 3, 1989. 7 fig, 9 tab, 1 fig.

Descriptors: *Lake Biwa, *Environmental effects, *Water level, *Lake restoration, *Eutrophic lakes, *Nutrients, *Water shortage, *Japan, *Water quality, Sediments.

The release of nutrients from vegetation and sediments is examined under conditions which simulate both calm and turbulent water motions in the nearshore, and the magnitude of nutrient loadings are estimated in relation to the specific effects of low lake level. Because of a lack of precipitation, water levels in Lake Biwa (Japan) were extremely low between the beginning of September 1984 and the end of February 1985. Approximately 13 million people depend upon the lake as a source of drinking water and for industrial use, and the severe water shortage became a serious concern for downstream communities. Also, there was concern that deterioration of water quality caused by rotting macrophytes and the release of nutrients from vegetation and nearshore sediments might create additional problems. Sample stations were established around the south shore of Lake Biwa. Sampling was undertaken at the time of low water and during the rising water levels. Sediment samples were particle sized into 7 groups (<2000 microm). Other measured values ranged as follows: (1) biological oxygen demand ranged from 0.5 to 1.3, (2) Chemical oxygen demand ranged from 1.2 to 3.5, (3) total phosphorus ranged from 0.019 to 0.037, (4) soluble reactive phosphorus ranged from 0.013 to 0.030, (5) soluble organic phosphorus ranged from 0.005 to 0.007, (6) total nitrogen ranged from 0.45 to 0.90, (7) NO2-N ranged from 0.004 to 0.007, (8) NO3-N ranged from 0.04 to 0.08, and (9) NH4-N ranged from 0.026 to 0.053, all as mg/L. The sample data suggest that, overall, there was little impact on lake water quality as a result of low water levels. However, remedial actions may have had an important and beneficial impact on nearshore water quality in the southern basin of Lake Biwa. (Author's abstract)
W90-00698

STUDY ON HEAVY METAL PARTITIONING IN SEDIMENTS FROM POYANG LAKE IN CHINA.
Beijing Univ. (China). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W90-00708

DISTRIBUTION OF NUTRIENTS, TRACE ELEMENTS, PAHS AND RADIONUCLIDES IN SEDIMENT CORES FROM LAKE VARESE (N. ITALY).
Istituto di Ricerca sulle Acque, Brugherio (Italy).
For primary bibliographic entry see Field 5B.
W90-00712

IMPORTANCE OF SEDIMENTS IN UNDERSTANDING NUTRIENT CYCLINGS IN LAKES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
C. Forsberg.
Hydrobiologia HYDRB8, Vol. 176/17, p 263-277, July 3, 1989. 6 fig, 40 ref.

Descriptors: *Limnology, *Lake sediments, *Nutrients, *Cycling nutrients, *Sediment-water interfaces, *Invertebrates, *Bioturbation, Mineralization, Water management.

The heterogeneous nature of nutrient cycling between lake sediments and water are examined in regard to three essential nutrients: (1) carbon, (2) nitrogen, and (3) phosphorus. Bacteria play a dominant role in the mineralization of dissolved and particulate organic material in the lake sediments since they drive the mineralization process by using the chemically bound energy of detritus. Benthic lake invertebrate fauna often show extreme heterogeneity in their distribution and population dynamics. Many of these invertebrates (oligocheates, amphipods, insect larvae and sphaerid and unionid clams) can play an important role in mediating nutrient speciation and transport between sediment and water through their burrowing, feeding, locomotion, respiratory and excremental activities. A significant portion of the major processes involved in nutrient cycling between lake sediments and water are biological ones (nutrient assimilation, microbial mineralization and bioturbation). As interactions exist between biological and chemical activities, changes in temperature can have dual effects on sediment nutrient cycling. This is illustrated for influences of temperature on microbial activity, oxygen conditions, bioturbation and nutrient cycling. An increase in temperature can, under suitable oxygen conditions, lead to increased bioturbation and increased nutrient cycling between sediment and water. On the other hand, a temperature increase will increase microbial activity and oxygen consumption, possibly resulting in oxygen depletion. This would reduce bioturbation and nutrient cycling. (Miller-PTT)
W90-00717

CHARACTERISTICS OF SETTLING MATTER AND ITS ROLE IN NUTRIENT CYCLES IN A DEEP OLIGOTROPHIC LAKE.
National Inst. for Environmental Studies, Ibaraki (Japan).
T. Fukushima, M. Aizaki, and K. Muraoka.
Hydrobiologia HYDRB8, Vol. 176/17, p 279-295, July 3, 1989. 11 fig, 5 tab, 27 ref.

Descriptors: *Limnology, *Oligotrophic lakes, *Nutrients, *Cycling nutrients, *Sedimentation, *Lake sediments, *Particulate matter, Chlorophyll a, Organic carbon, Nitrogen, Phosphorus, Japan.

The results of laboratory experiments performed on decomposition of entrapped particulate matter are compared with those obtained from a series of vertical traps in an oligotrophic lake with a maximum depth of 163 m (Lake Chuzenji Japan). The settling flux of seston (dry weight, DW), chlorophyll a (Chla), particulate organic carbon (POC), particulate organic nitrogen (PON), and particulate phosphorus (PP) was measured monthly in 1981-83 at 10 different depths. The Ti concentration in entrapped matter was used to separate the sedimentation flux into allochthonous and autochthonous components. Inflow loads of dissolved nutrients were almost sufficient to supply the autochthonous fluxes at 30 m and this flux of POC (26.6 g/sq m/a) was about one-third of primary production (84 g C/sq m/a). Sedimentation of particulate matter was the main path of losing nutrients from lake water, explaining more than 80% removal of inflow loads. Decomposition rates during sedimentation which were calculated from the vertical difference in the autochthonous flux agreed very closely with the results obtained by laboratory experiments of a 100-day incubation. These decomposition rates and those near the sediment interface were used to explain dissolved oxygen depletion and nitrate increase in the hypolimnion during stratification. The average sinking velocities were 1.82 m/d for seston and 1.16 m/d for Chl a at 30 m; they were influenced by the Chl a content of seston. (Author's abstract)
W90-00718

COUPLING OF STRONTIUM AND CALCIUM CYCLES IN LAKE CONSTANCE.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
H. Stabel.
Hydrobiologia HYDRB8, Vol. 176/17, p 323-329, July 3, 1989. 7 fig, 21 ref.

Descriptors: *Sediment-water interfaces, *Strontium, *Calcium, *Limnology, *Water chemistry, *West Germany, Lake Constance, Seasonal variation, Sedimentation, Coupling.

The contents of Sr and Ca were measured weekly in Lake Constance in 1986. Epilimnetic concentrations of Ca changed between 0.0013 (during homothermy) and 0.009 mol/l (during thermal stratification). The seasonal fluctuations of Ca were correlated with those of Sr (between 4.61 and 5.36 micromol/l). The epilimnion was permanently over-saturated with respect to calcite but not with respect to SrCO3. Analysis of the settling process by use of sedimentation traps revealed two short episodes of very high authigenic settling fluxes of CaCO3, triggered by phytoplankton diatoms. Seasonal changes of the Ca contents (between 4.1 and 30.7 percent of the dry weight) and of the Sr concentrations (from 0.012 to 0.075 percent) in the settling material were closely correlated. This suggests a coprecipitation mechanism with a nearly constant stoichiometry of (atoms Sr/atoms Cr) times 1000 of 0.84. Coprecipitation of Sr ad Ca with organic matter was insignificant. In the hypolimnion, some of the Sr and Ca were released from the settling material. These results strongly suggest that the cycle of Sr in Lake Constance is driven predominantly by coprecipitation with calcite. The principal chemical mechanisms leading to coprecipitation are discussed. (Author's abstract)
W90-00721

MICROORGANISMS AND THE AQUATIC ENVIRONMENT.
Melbourne Univ., Parkville (Australia). Dept. of Microbiology.
N. F. Millis.
Hydrobiologia HYDRB8, Vol. 176/17, p 355-368, July 3, 1989. 7 fig, 3 tab, 26 ref.

Descriptors: *Aquatic environment, *Lakes, *Limnology, *Marine environment, *Nutrients, *Microorganisms, *Limiting nutrients, Growth, Nitrogen, Phosphorus, Scavenging.

The general relationship between growth rate and the concentration of limiting substrate shows that, in environments with very low concentrations of substrate, some organisms will be more successful in scavenging substrates than others. The content of nitrogen and phosphorous in the cells was measured and several important points emerged. Oscillatoria took up nitrate-N and ammonia-N at similar rates under all conditions. The rate was not affected by growth rate when nitrate limited growth. When phosphate limited growth, the rate of uptake of nitrogen declined steadily with increase in growth rate. When energy limited growth (N and P in excess), the uptake of nitrogen increased as growth rate increased, but the cells had a very poor capacity to take up nitrogen in contrast to cells grown in N-limitation. Studies in the chemostat have illustrated how flexibly organisms can respond to different nutrient limitations at concentrations likely to occur in nature. The chemostat itself can be used to isolate the organisms which normally live with low concentrations of nutrients, and are present in small numbers growing at slow rates. An estimate is provided for the percentage of carbon in sediments of a profundal zone of a freshwater lake which is oxidized with different acceptors. In shallow, marine sediments, the sulfate reduction is more important. It is equivalent to 60% of the carbon metabolized by aerobic respiration and methanogenesis is negligible. (Miller-PTT)
W90-00724

SEDIMENT TOXICITY TESTING IN TWO AREAS OF CONCERN OF THE LAURENTIAN

GREAT LAKES: TORONTO (ONTARIO) AND TOLEDO (OHIO) HARBOURS.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 5C.
W90-00727

TOXICITY OF METAL POLLUTED SEDIMENTS TO DAPHNIA MAGNA AND TUBIFEX TUBIFEX.
National Swedish Environment Protection Board, Uppsala (Sweden).
For primary bibliographic entry see Field 5C.
W90-00728

SPATIAL AND TEMPORAL VARIATION OF HEAVY METALS IN SEDIMENT CORES FROM THE CALCASIEU RIVER/LAKE COMPLEX.
McNeese State Univ., Lake Charles, LA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-00808

GEOCHEMICAL STUDIES IN A REMOTE SCOTTISH UPLAND CATCHMENT II. STREAMWATER CHEMISTRY DURING SNOW-MELT.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W90-00809

VARIABILITY IN THE DETERMINATION OF ASH FREE DRY WEIGHT FOR PERIPHYTON COMMUNITIES: A CALL FOR A STANDARD METHOD.
Victoria Univ. (British Columbia). Dept. of Biology.
C. I. Ridley-Thomas, A. Austin, W. P. Lucey, and M. J. R. Clark.
Water Research WATRAG, Vol. 23, No. 6, p 667-670, June 1989. 3 fig, 2 tab, 20 ref. Science Council of British Columbia Research Grant No. 90 (RC-15), National Science and Engineering Research Council of Canada Research Grant A9537.

Descriptors: *Biological samples, *Epiphytes, *Tissue analysis, *Plant tissues, *Dry matter, *Laboratory methods, *Standards, Ecosystems, Biofilms, Data acquisition.

An evaluation of diverse procedures for determining ash free dry weight (AFDW) has been carried out on a homogeneous periphyton biofilm. Results indicate a considerable degree of variability in AFDW depending on ignition time, ignition temperature and sample size. A standard method is called for; in the interim it is recommended that all three variables be reported to facilitate comparisons. Caution should be exercised when comparing results gained using dissimilar or incompletely quoted procedures. (Author's abstract)
W90-00820

ADSORPTION-DESORPTION OF PHOSPHORUS BY LAKE SEDIMENTS UNDER ANAEROBIC CONDITIONS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
H. Furumai, and S. Ohgaki.
Water Research WATRAG, Vol. 23, No. 6, p 677-683, June 1989. 9 fig, 4 tab, 12 ref.

Descriptors: *Limnology, *Nutrients, *Path of pollutants, *Fate of pollutants, *Eutrophication, *Cycling nutrients, *Lake sediments, *Anaerobic conditions, *Sorption, *Phosphorus, Radioactivity techniques, Hydrogen ion concentration, Japan.

Adsorption-desorption reactions of phosphorus by lake sediments were studied using a radioisotope 32P inorganic phosphate. The sediments were collected at Lake Kasumigaura, Japan. The amount of isotopically exchangeable phosphorus in the sediments was measured in Anaerobic sediments-water batch systems under various pH and phosphorus concentrations. The steady state condition practically prevailed with respect to 32P within 30 min and the amount of exchangeable phosphorus in the sediments was calculated based on the steady state data. The results were compared with data previously obtained under aerobic conditions. The anaerobic conditions caused a large phosphorus release and an increase in exchangeable phosphorus especially below pH 8. The exchangeable phosphorus under anaerobic conditions ranged from 27 to 49% of the total phosphorus in the sediments of Lake Kasumigaura, respectively, for pH in the range of 5-10. The relationship between the phosphorus concentration in the liquid phase and the amount of exchangeable phosphorus in the solid phase under anaerobic conditions can be explained by the Langmuir equilibrium model as well as under aerobic conditions. The bonding energy constant and adsorption maximum proved to be useful parameters for evaluating the effect of redox level and pH on the exchange reaction. The bonding energy constants under aerobic and anaerobic conditions ranged from 4.6 to 13.0, and from 1.2 to 2.3 (L/mg) for pH in the range of 6-7, respectively. The adsorption maxima were higher under anaerobic conditions than aerobic conditions. For pH between 5.7 and 6.6, the increase in pH caused an increase in the bonding energy constant, but had only a slight influence on the adsorption maximum under anaerobic conditions. (Author's abstract)
W90-00822

PHOSPHORUS EXCHANGE KINETICS AND EXCHANGEABLE PHOSPHORUS FORMS IN SEDIMENTS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
For primary bibliographic entry see Field 5B.
W90-00823

INORGANIC AND METHYL MERCURY IN INLAND WATERS.
Cagliari Univ. (Italy). Ist. di Igiene e Medicina Preventiva.
For primary bibliographic entry see Field 5B.
W90-00825

OBSERVATIONS OF CONCURRENT DRIFTING BUOY AND CURRENT METER MEASUREMENTS IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
A. H. Clites.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 197-204, 1989. 5 fig, 12 ref.

Descriptors: *Lake Michigan, *Water currents, *Satellite technology, *Current meters, Buoys, Wind-driven currents, Wave action.

Data generated by satellite-tracked drifting buoys released in the Great Lakes are being used to study lake circulation and test trajectory prediction models. Before data from drifters can be used with confidence, the water-tracking accuracy of the drifters must be known. During the winter of 1983, drogued drifters were released in Lake Michigan in the vicinity of an array of vector-averaging current meters. Several times during the next 3 months, the drifters moved within a few kilometers of one of the current meters and remained in the vicinity for up to 30 hours. The average wind effect that best aligns the currents measured by the moored current meters and the currents from drifter paths is 0.76% of the wind speed. This value is the weighted average of the wind effects calculated for seven separate cases, which ranged from 0.06% to 2.09% of the wind speed. The average value is in good agreement with theoretical estimates and field test results. The horizontal coherence of the currents within 5 km was fairly high as revealed by comparisons between drifter trajectories and current meter progressive vectors. The separation distance between the vectors was generally under 1 km while drifter path length ranged from 4 to 9 km. Results indicate that during these encounters, about 25% of the variability between trajectories estimated by drifting buoys and current meter measurements is explained by a simple wind correction. The remaining discrepancy is attributed to wave action (Stokes drift) and data limitations such as a lack of overlake wind conditions. (Author's abstract)
W90-00839

FOOD OF FORAGE FISHES IN WESTERN LAKE ERIE, 1975-76.
Fish and Wildlife Service, Sandusky, OH. Biological Station.
K. M. Muth, and W. N. Busch.
International Association for Great Lakes Research JGLRDE, Vol. 15, No. 2, p 217-222, 1989. 2 fig, 2 tab, 21 ref.

Descriptors: *Fish, *Fish food organisms, *Fish food, *Fish populations, *Lake Erie, Shiner, Trout-perch, Alewife, Shad, Bass, Drum, Young of the year, Waterfleas, Copepods, Diptera, Ostracoda, Amphipods, Algae.

In western Lake Erie in the summer and fall of 1975-1976, food eaten by seven forage fishes--emerald shiner (Notropis atherinoides), spottail shiner (Notropis hudsonius), trout-perch (Percopsis omiscomaycus), and young-of-the-year (YOY) of alewife (Alosa pseudoharengus), gizzard shad (Dorosoma cepedianum), white bass (Morone chrysops), and freshwater drum (Aplodinotus grunniens)--was divided among six major taxa: Cladocera, Copepoda, Diptera, Ostracoda, Amphipoda, and Algae. In addition, fish were eaten by YOY white bass, and Rotifera were consumed by YOY gizzard shad. Interspecies diet overlap indices, calculated to compare the food of the different species and to evaluate diet similarities, were usually highest for YOY white bass and YOY freshwater drum when compared with the other species and usually lowest between emerald shiners and all other forage fishes. Understanding the feeding interactions among fishes that could influence production at the forage-food level of the food web could provide insight into how cascading trophic interactions influence the production of piscivorous predators. (Author's abstract)
W90-00841

PRODUCTION, BIOMASS, AND TROPHIC INTERACTIONS OF MYSIS RELICTA IN LAKE ONTARIO.
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
M. A. Shea, and J. C. Makarewicz.
International Association for Great Lakes Research JGLRDE, Vol. 15, No. 2, p 223-232, 1989. 10 fig, 3 tab, 32 ref.

Descriptors: *Lake Ontario, *Zooplankton, *Limnology, *Fish food organisms, Abundance, Biomass, Production, Mysis, Alewives, Salmonines.

Mysis relicta was sampled in Lake Ontario biweekly with vertical tows from May through November 1984. Two sites were studied off Hamlin Beach State Park, one station at 35 m and the other at 100 m. At the 35-m station, total abundance ranged from near zero in late September to 207 organisms/sq m in mid-August, with a mean abundance of 48 organisms/sq m for the study period. Average biomass and production values at the 35-m station were 0.08 g dry weight/sq m and 0.13 g dry weight/sq m per 7 months, respectively. At the 100-m station, total abundance ranged from 110/sq m in late September to 860/sq m in mid-July, with a mean abundance of 378/sq m for the study period. Average biomass and total production at the 100-m station was 0.68 g dry weight/sq m and 1.23 g dry weight/sq m per 7 months, respectively. Mysis relicta abundance increased from 1971 to 1984 in the offshore and nearshore of Lake Ontario. This increase in abundance may be related to the stocking of salmonines in Lake Ontario and/or to the significant die-off of adult alewives in the winter of 1983-1984. (Author's abstract)
W90-00842

INFLUENCE OF LAKE SURFACE AREA AND DEPTH UPON THERMAL STRATIFICATION AND THE DEPTH OF THE SUMMER THERMOCLINE.
Minnesota Univ., Minneapolis. Dept. of Ecology

and Behavioral Biology.
E. Gorham, and F. M. Boyce.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 233-245, 1989. 5 fig, 3 tab, 24 ref.

Descriptors: *Thermal stratification, *Lakes, *Limnology, *Thermocline, Wind-driven currents, Depth, Seiches, Surface area, Storms, Gravitational acceleration.

Among the important physical characteristics of a lake are whether it stratifies seasonally, and if so, the depth to which wind-mixing is limited by the stratification. It is generally known that sufficiently shallow lakes tend to remain isothermal throughout the year and that the depth of the thermocline in stratified lakes correlates positively with the surface the temperate zone of the northern hemisphere show that whether a lake stratifies depends on both the maximum depth and the surface area of the lake, whereas the depth of the thermocline depends primarily on the surface area. A modification of previously published scaling arguments provides a plausible theoretical basis for some of this behavior. These arguments account for additional shear-induced mixing associated with the fundemental internal seiche in small lakes and with near-inertial motion in big lakes. For lakes of cross-basin diameter less than 5,000 m (surface area less than 25 sq km), an estimate of the depth of the thermocline at the time of maximum heat content is given by an equation whereby tau is the wind stress associated with late summer storms, Delta P is the density contrast between epilimnion and hypolimnion typical for lakes in that region near the time of maximum heat content, g is the gravitational acceleration, and L is the square root of the surface area of the lake. A consistent set of units must be employed. (Author's abstract)
W90-00843

LEAD AND CADMIUM LOADINGS TO THE GREAT LAKES FROM PRECIPITATION.
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
For primary bibliographic entry see Field 5B.
W90-00844

TEMPORAL AND SPATIAL VARIABILITY IN SEDIMENT AND PHOSPHORUS LOADS TO LAKE SIMCOE, ONTARIO.
Department of Fisheries and Oceans, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W90-00845

MODELING THE LONG-TERM BEHAVIOR OF AN ORGANIC CONTAMINANT IN A LARGE LAKE: APPLICATION TO PCBS IN LAKE ONTARIO.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5B.
W90-00846

AGE VERIFICATION OF WALLEYES FROM LAKE OF THE WOODS, MINNESOTA.
Minnesota Univ., St. Paul. Dept. of Fisheries and Wildlife.
R. F. Frie, J. K. Anderson, and M. J. Larson.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 298-305, 1989. 4 fig, 4 tab, 15 ref.

Descriptors: *Limnology, *Fish populations, *Lake fisheries, *Quality control, *Walleye, Minnesota, Fish scales, Age verification, Dorsal spine.

Walleyes are the major resource of commercial and recreational fisheries in Lake of the Woods, as well as in other large, relatively shallow lakes in northern latitudes. Verified age assignments are necessary for assessment of mortality and year class strength. In this study, ages were assigned by an experienced reader independently of fish length and knowledge of previous age assignments. Scale ages were compared with dorsal spine ages for 850 walleyes by determining the percent agreement, average percent error, coefficient of variation, and index of precision. Likewise, scale age assignments were compared among three readers of widely varying experience. Results were consistent with other studies in that walleye scales are relatively easy to age from Lake of the Woods, Minnesota, and other high latitude, nutrient-rich lakes containing exploited populations. Variation among readers increased for walleyes over 430 mm, but bias toward under-ageing (as compared with spines) did not occur until age 12 and older (600 mm). Chi-square tests revealed no significant differences among age distributions formulated from spines, scales, and different readers. Lack of serious trends in deviation of scale readings from spine readings allows the less expensive scale method to be employed with little danger of underestimating ages of most sizes of walleye caught by angling and experimental gill nets. (Author's abstract)
W90-00847

POTENTIAL INVASION OF THE GREAT LAKES BY FISH SPECIES ASSOCIATED WITH CLIMATIC WARMING.
Toronto Univ. (Ontario). Dept. of Zoology.
N. E. Mandrak.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 306-316, 1989. 2 fig, 3 tab, 60 ref.

Descriptors: *Limnology, *Great Lakes, *Carbon dioxide, *Fish migration, *Ecological distribution, *Distribution patterns, *Climates, *Greenhouse effect, Geographical distribution, Invading species, Fish populations.

Global warming associated with increasing atmospheric levels of carbon dioxide and other gases (i.e., the greenhouse effect) has been widely predicted. Changes in the terrestrial vegetation (as predicted by a global model using the Holdridge Life Zone Classification, based an current temperature and precipitation patterns) were used as an indication of future regional changes in eastern North America due to climatic warming. This warming process would likely alter the geographic distribution of numerous fish species in the Great Lakes region. The probability of 58 common, widely distributed species invading the upper Great Lakes (Lake Huron and Superior) from the lower Great Lakes (Lakes Michigan, Erie, and Ontario), and the lower Great Lakes from the Mississippi and Atlantic Coastal basins was assessed by comparing ecological characteristics of possible invaders to those of 11 recently invading species, using discriminant function and principal components analyses. Twenty-seven of these 58 species were judged to be potential invaders of the Great Lakes as a response to climatic warming. These invading species would dramatically alter the present Great Lakes fish communities. (Author's abstract)
W90-00848

YELLOW PERCH (PERCA FLAVESCENS) GROWTH AND MORTALITY RATES IN LAKE ST. CLAIR AND THE THREE BASINS OF LAKE ERIE, 1963-86.
Ontario Ministry of Natural Resources, Maple. Fisheries Branch.
B. A. Henderson, and S. J. Nepszy.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 317-326, 1989. 7 fig, 2 tab, 23 ref.

Descriptors: *Fish populations, *Perch, *Lake Erie, Lake fisheries, Growth, Mortality, Yellow perch, Population density, Community structure, Primary productivity.

Growth and mortality rates differed among the three stocks of yellow perch (Perca flavescens) examined in Lake Erie from 1978 to 1985 in samples obtained from multi-mesh gillnets set in May and July. Growth rates were significantly greater in the central basin than in either the western or eastern basins for yellow perch sampled from four year-classes (1976-79). The lowest growth rates were found among yellow perch from the western basin in the May and July sampling periods. Pooling each age class from 1978 to 1985, we showed that perch from the central basin were usually larger at age. These differences in size at age and growth rates were not explained satisfactorily by differences in population density and water temperature among the basins but could be attributed in part to differences in primary production and fish community structure. Size at age in trawl samples tended to decline in all basins, and particularly in the western basin and Lake St. Clair since the late 1970s. We suggest that this decline in size may have been caused by both a decrease in primary productivity and the increase in the abundance of white perch (Morone americana). From estimations of total mortality rates derived from cohort catch curves (ages 3-6, 1975-79 year-classes) and annual changes in relative abundance, we concluded that total mortality (Z) was positively correlated with commercial fishing effort (western>central>eastern). (Author's abstract)
W90-00849

DETERMINATION OF IRRADIATION AND PRIMARY PRODUCTION USING A TIME-DEPENDENT ATTENUATION COEFFICIENT.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
R. P. Bukata, J. J. Jerome, and J. E. Burton.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 327-338, 1989. 11 fig, 4 tab.

Descriptors: *Primary productivity, *Irradiation, *Limnology, *Solar radiation, *Photosynthesis, Vollenweider-Fee model, Attenuation, Diurnal variation, Seasonal variation, Water depth, Lake Erie, Lake Ontario, Superior.

A time-dependent vertical irradiance attenuation coefficient (k sub v) is utilized in conjunction with the Vollenweider-Fee primary production model to determine the effect of the diurnal variation of solar zenith angle on estimations of primary production and irradiation. Such effects are considered as a function of both geographic latitude (northern hemisphere) and time of year. It is shown that the effects of solar zenith angle dependence of the vertical irradiance attenuation coefficient on the determination of daily primary production is small (< + or -15%) for any latitude or time of year. The effect of solar zenith angle dependence of the vertical irradiance attenuation coefficient on the determination of irradiation at a given depth, however, can be quite significant. Examples of this impact on irradiation determinations in Lakes Superior, Ontario, and Erie are presented, as is the fact that such inaccuracies in both irradiation and primary production estimates may be dramatically minimized by a judicious selection of solar zenith angle at which to determine a single value of k sub v. For the Great Lakes latitudes, this solar zenith angle range is 36-70 degrees depending upon location and time of year. (Author's abstract)
W90-00850

ATMOSPHERIC DEPOSITION OF CHEMICAL CONTAMINANTS TO THE GREAT LAKES.
Rhode Island Univ., Narragansett. Center for Atmospheric Chemistry Studies.
For primary bibliographic entry see Field 5B.
W90-00851

FACTORS AFFECTING RECRUITMENT AND MORTALITY RATES OF RAINBOW SMELT (OSMERUS MORDAX) IN LAKE ERIE, 1963-85.
Ontario Ministry of Natural Resources, Maple. Fisheries Branch.
B. A. Henderson, and S. J. Nepszy.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 357-366, 1989. 8 fig, 3 tab, 28 ref.

Descriptors: *Fish populations, *Lake Erie, *Smelt, *Lake fisheries, *Fish stocking, Spawning, Stock-size, Recruitment, Temperature, Predation, Size.

Recruitment of young-of-the-year (YOY) rainbow smelt (Osmerus mordax) per parent was not dependent upon water temperature (rate of warming and average temperature) during spawning, Glugea infestation, or parental stock-size. Only in the eastern basin of Lake Erie was recruitment to age 1 + years-old positively correlated with the YOY index in the preceding summer. Recruitment

of age 1+ year old smelt was not related to parental stock-size. Recruitment (age 1+ years-old) per spawner was inversely related to the abundance of age 1 year-old smelt present during the year of hatch in both the eastern and central basins of Lake Erie. This could be taken as evidence to support the hypothesis that the alternating dominance of year-classes (1963-74) was caused by cannibalism of YOY by age 1 year-old smelt. After 1974, alternating year-class-dominance was not evident; we considered three possible explanations for the absence of strong year-classes. First, the size at age declined in both basins during the study so that more age classes could have fed optimally on young-of-year (YOY), resulting in a poorer survival of YOY smelt. Second, the harvest of smelt increased greatly after 1974, particularly for yearling smelt, so that year-class strength measured by the abundance of yearlings was reduced by fishing. Third, predation on smelt by stocked salmonids probably increased after 1974 as the stocking rates increased. Adult total mortality rates (ages 2 and 3 years-old) were positively related to stock density providing some evidence for density dependent mortality of smelt. There was no evidence that the variations in adult mortality were associated with the incidence of Glugea. (Author's abstract)
W90-00852

PARTITIONING OF ZINC BETWEEN THE WATER COLUMN AND THE OXIC SEDIMENTS IN LAKES.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W90-00853

PREDICTION OF NUISANCE PERIPHYTIC BIOMASS: A MANAGEMENT APPROACH.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W90-00899

TOXIC CYANOBACTERIA AND WATER QUALITY PROBLEMS--EXAMPLES FROM A EUTROPHIC LAKE ON ALAND, SOUTH WEST FINLAND.
Abo Akademi, Turku (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W90-00908

OVER-WINTER CHEMISTRY OF SUBARCTIC FENS, EASTERN CANADA.
McGill Univ., Montreal (Quebec). Dept. of Geography.
C. M. Kingsbury, and T. R. Moore.
Nordic Hydrology NOHYBB, Vol. 20, No. 2, p 97-108, 1989. 3 fig, 1 tab, 26 ref.

Descriptors: *Water chemistry, *Peat, *Fens, *Cold regions, *Subarctic zone, *Peat, *Wetlands, Freeze-thaw cycles, Snowmelt, Hydrogen ion concentration, Groundwater, Conductance, Nutrients, Dissolved organic carbon, Phosphorus, Ammonium, Nitrates.

Two subarctic fens (one nutrient-poor, one nutrient-rich) were sampled from October, 1984 to July, 1985 near Schefferville, northern Quebec. The changes in concentrations of chemicals (pH, conductance, Ca, Mg, Na, K, Fe, dissolved organic carbon, P, NH4(+)-N and NO3(-)-N) dissolved in the peat water were identified during the freeze-thaw cycle. The highest chemical concentrations were in the winter (associated with the ice formation process), followed by the spring-summer, then fall. Four main processes influenced the concentration of dissolved chemicals in subarctic fens: (1) Snowmelt diluted the peat water; (2) Freezing of the peat increased concentrations of dissolved nutrients and other chemicals, believed to originate from biological sources; (3) Further increases in concentrations over the winter were caused by the incorporation of peat water, which migrated into the frozen peat; (4) Thawing of peat influenced the water chemistry by combining the release of the above 3 processes, along with biotic utilization. The freeze-thaw cycle in the subarctic fens appeared to increase the availability of important nutrients (such as phosphorous) during the spring. (Author's abstract)
W90-00919

MEASURING GROUNDWATER TRANSPORT THROUGH LAKE SEDIMENTS BY ADVECTION AND DIFFUSION.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2F.
W90-00947

2I. Water In Plants

POTENTIAL ROLE OF ROOTS AND RHIZOMES IN STRUCTURING SALT-MARSH BENTHIC COMMUNITIES.
North Carolina Univ., Wilmington. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W90-00280

SALT TOLERANCE OF FIVE MUSKMELON CULTIVARS.
Haryana Agricultural Univ., Hissar (India). Dept. of Vegetable Crops.
For primary bibliographic entry see Field 3F.
W90-00281

SEEDLING GROWTH RESPONSE IN A GREENHOUSE TO FOUR RATES OF OLD AND NEW PAPER MILL SLUDGE.
Arkansas Univ. at Monticello. Dept. of Forest Resources.
For primary bibliographic entry see Field 5E.
W90-00283

WATER USE EFFICIENCY, NUTRIENT UPTAKE AND PRODUCTIVITY OF MICRO-IRRIGATED CITRUS.
New South Wales Dept. of Agriculture, Yanco (Australia). Agricultural Research Centre.
For primary bibliographic entry see Field 3F.
W90-00290

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. I. ROOT AND SHOOT GROWTH.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 3F.
W90-00317

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. III. DRY MATTER, WATER USE AND LIGHT INTERCEPTION.
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 3F.
W90-00319

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. IV. THE INFLUENCE OF POPULATION ON WATER SUPPLY AND DEMAND.
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 3F.
W90-00320

VARIATION OF SOIL WATER REGIME, OXYGEN STATUS AND ROOTING PATTERN WITH SOIL TYPE UNDER SITKA SPRUCE.
Aberdeen Univ. (Scotland). Dept. of Soil Science.
T. R. Nisbet, C. E. Mullins, and D. A. MacLeod.
Journal of Soil Science JSSCAH, Vol. 40, No. 1, p 183-197, March 1989. 6 fig, 2 tab, 33 ref.

Descriptors: *Waterlogging, *Spruce trees, *Soil-water-plant relationships, *Peat soils, *Forest soils, *Root development, Soil water, Soil properties, Oxygen.

Soil water regime, oxygen status and rooting pattern under Sitka spruce were characterized in five soil types: a waterlogged peaty gley, a peaty gley, a flushed peaty gley, a surface water gley and a brown forest soil during 1982. The waterlogged peaty gley had a high water-table which only dropped below 30 cm depth for 46 days during the summer. Below the water-table the profile was anoxic and rooting was restricted to a depth of 12 cm. The peaty gley experienced seasonal waterlogging with a winter water-table around 15 cm depth. Roots that grew further down the profile during the summer as the topsoil dried to -100 kPa matric potential were later killed when the water-table rose. The top 30 cm of the flushed peaty gley remained oxygenated even below the water-table. Roots survived below the winter water-table. The top 30 cm of the surface water gley and brown forest soil were freely draining and remained aerated throughout the year. The platinum electrode polarographic method demonstrated that there was a sharp transition to anoxic conditions just above the water-table at the first two sites. (Author's abstract)
W90-00324

SIMPLE EMPIRICAL MODEL OF ROOT WATER UPTAKE.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
N. J. Jarvis.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 57-72, March 30 1989. 8 fig, 3 tab, 25 ref.

Descriptors: *Root zone, *Aeration zone, *Vadose water, *Soil water, *Model studies, *Soil-water-plant relationships, Absorption, Transpiration.

An empirical sink function describing water extraction by roots is proposed. Water uptake is given as a function both of the potential transpiration rate and a weighted stress index that accounts for the effects of the vertical distributions of roots and soil water content. The model was tested in the field using measurements of water content in a clay soil in which oats, spring rape and mustard crops were grown under mobile shelters. Measured changes in soil water content were considered primarily due to root water uptake, since recharge was prevented and the redistribution of water assumed negligible. Best-fit parameter values were found by optimization during one experimental year. Model predictions compared well with measurements in two further years (r squared values of 94 and 81%), with no change in the optimized parameter input values. (Author's abstract)
W90-00355

EFFECT OF DRAINAGE WATER ON NODULATION, NITROGEN FIXATION AND GROWTH OF FABA BEAN.
King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
O. A. Al-Tahir, A. A. Al-Noaim, and A. A. Al-Jasim.
Biological Wastes BIWAED, Vol. 29, No. 1, p 63-66, 1989. 3 tab, 8 ref.

Descriptors: *Legumes, *Irrigation water, *Nitrogen fixation, *Drainage water, Fava beans, Nodules, Growth, Salinity, Conductivity.

Faba bean (Vicia faba L) was grown in pots with sandy soil under normal, drainage, and 1:1 mixture of irrigation water, having electrical conductivities of 2.5, 11.5, and 6.7 mmhos/cm, respectively. The dry weight of root, stem and leaves of the beans decreased with increasing levels of salinity, but there were no significant differences between the effects of the normal and the 1:1 mixture of irrigation water although both differed significantly from the drainage water results. The fresh weight and numbers of nodules also showed that their growth was much reduced with drainage water. The salinity of the irrigation water reduced the number and weight of nodules, N2-fixing efficiency, and dry weight of shoots and roots. However,

the effects of normal irrigation water and 1:1 mixture of drainage and normal irrigation water on the processes of nodule production, growth, and N2 fixation were not significantly different. (White-Reimer-PTT)
W90-00535

EFFECTS OF OZONE AND WATER STRESS, SEPARATELY AND IN COMBINATION, ON SOYBEAN YIELD.
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
J. E. Miller, A. S. Heagle, S. F. Vozzo, R. B. Philbeck, and W. W. Heck.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 330-336, Jul-Sep 1989. 4 fig, 7 tab, 20 ref.

Descriptors: *Air pollution effects, *Ozone, *Water stress, *Soybeans, Soil water, Rain exclusion caps, Growth, Crop yield.

A primary concern in applying existing O3-effects data on crop production is the relatively unknown influence of soil moisture, which may modify plant response to O3. In 1986 a field experiment was performed with soybean (Glycine max. (L.) Merr. cv. Young) to test the influence of periodic water stress on the yield response to O3. Open-top field chambers were used to expose plants to a range of O3 concentrations, and rain exclusion caps were used on individual chambers to help regulate soil moisture levels. Three soil moisture treatments were used: (1) well-watered (WW); (2) water-stressed (WS); and (3) well-watered with permanent rain exclusion caps that were in place from 35 d after planting until physiological maturity (WW-C). In the WW and WS treatments, the raincaps were put in place only during an exceptionally wet period from mid-August to mid-September. The WW and WW-C treatments had approximately the same yield and response to O3, indicating that the presence of the caps for most of the growing season had little effect on growth or sensitivity to O3. The WS plants yielded approximately 10% less on the average than the WW and WW-C plots, but water stress did not change the response to O3 (i.e., no significant O3 x water interaction). Based on the Weibull dose-response model, O3 reduced yield of 'Young' soybean 13% at a concentration of 0.05 microL/L (12h/d seasonal mean) compared to a hypothetical background of 0.02 microL/L. (Author's abstract)
W90-00569

DETECTION OF MOISTURE STRESS BY INDICATOR PLOTS--A SIMULATION.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
R. Prasad.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 11-24, July 1989. 8 fig, 1 tab, 10 ref.

Descriptors: *Moisture stress, *Crops, *Agriculture, *Soil moisture retention, Indicator plots, Simulation, Sand, Compaction.

The possibility of detecting advance indications of moisture stress in crops by using an analytical simulation of small prepared plots with compacted or partially sand-substituted soils is examined. A series of soils and three crops were considered for the simulation, and the moisture characteristics of the soils were calculated with an available model. A sand indicator plot is prepared by mixing sand with the soil in the root zone. Because of the reduced moisture retention in the indicator plot, the crop in the plot will show signs of moisture stress earlier that the rest of the crop. In a compacted plot the soil is compacted in order to reduce the moisture holding capacity. The results indicate that the concept of using a small plot with partially sand-substituted or compacted soil to obtain advance indication of moisture stress appears feasible. For certain soil, however, the sand-substitution method fails, while compaction can be adopted for all soils. The crop grown on the indicator plot showed signs of stress one to three days ahead of the rest of the land in most cases, depending on the depletion level at which moisture stress was evident. The advance interval generally decreases with decreasing root depth, and the effect of intervening rainfall on the advance interval is very small. (White-Reimer-PTT)
W90-00574

INFLUENCE OF THE OVERSTORY, UNDERSTORY AND UPPER SOIL HORIZONS ON THE FLUXES OF SOME IONS IN A MIXED DECIDUOUS FOREST.
Toronto Univ. (Ontario). Dept. of Geography.
A. G. Price, and R. J. Watters.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 185-197, July 1989. 2 fig, 4 tab, 32 ref.

Descriptors: *Nutrients, *Cycling nutrients, *Water chemistry, *Chemistry of precipitation, *Throughfall, *Forests, *Stemflow, *Ontario, Ions, Mixed forest, Overstory, Understory, Soil horizons, Chemical flux, Nutrients, Minerals, Aspen, Birch.

Chemical fluxes were measured in precipitation passing through the overstory, understory and upper soil horizon within an aspen-birch forest in Ontario, for ten rain events occurring between May and August 1985. Analysis of mean event chemical fluxes for pH, Ca, Mg, K, SO4, NO3, Alkalinity, and PO4 showed that the dominant control on nutrient transfers through aspen systems was that exerted by the overstory. Nutrient transfers through the birch overstory and hazel understory canopy were of a similar magnitude. Hydrochemical changes through the understory below aspen were of the same general type as those occurring within the overstory but only about one-third as large. Overstory throughfall generally contributed a much larger solute load than stemflow, ranging, on average for all ions, from four times larger (for largetooth aspen) to 130 times larger (for trembling aspen). Understory stemflow contributed about six times more solutes than understory throughfall (on average for all ions). The dominance of throughfall in overstories and of stemflow in understories, may be explained by a larger stem area index for understory stems compared with that of tree trunks. Chemical inputs to the mineral B horizons of the soil are controlled by the frequency of heavy rains and by chemical changes in, and withdrawals from, the upper soil during smaller precipitation events. (Author's abstract)
W90-00585

EFFECTS OF THREE IRRIGATION REGIMES ON GROWTH PARAMETERS AND YIELD OF DRIP IRRIGATED SWEET CORN (ZEA MAYS CV. SURESWEET) (TRES NIVELES DE RIEGO, CRECIMIENTO Y RENDIMIENTO DE MAIZ DULCE (ZEA MAYS CV. SURESWEET) REGADO POR GOTEO).
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
For primary bibliographic entry see Field 3F.
W90-00586

SEASONAL CONSUMPTIVE USE OF WATER BY BELL AND CUBANELLE PEPPERS IN SEMIARID AND HUMID COASTAL SITES IN PUERTO RICO.
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
M. R. Goyal, and E. A. Gonzalez.
Journal of Agriculture of the University of Puerto Rico, Vol. 72, No. 4, p 609-614, October 1988. 1 fig, 1 tab, 6 ref.

Descriptors: *Vegetable crops, *Agriculture, *Irrigation requirements, Temperature, Rainfall, Puerto Rico, Peppers, Growing cycle, Seasonal variation.

Consumptive use (CU) values were estimated for transplanted bell and Cubanelle peppers having a 120-day growing cycle with 24 planting dates and 2 locations (Fortuna Substation, Juana Diaz and Isabela Substation, Isabela). A modified Blaney-Criddle model was used to estimate monthly CU with temperature and rainfall data. CU at Fortuna was greater than CU at Isabela in all planting schedules. CU varied from 401-524 mm at Fortuna and 365-484 mm at Isabela. An example is presented to estimate seasonal net irrigation requirements with CU. (Author's abstract)
W90-00590

UPTAKE OF TRITIATED GROUNDWATER BY BLACK LOCUST TREES.
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Rickard, and K. R. Price.
Northwest Science NOSCAX, Vol. 63, No. 3, p 87-89, May 1989. 1 fig, 1 tab, 4 ref. U.S. Department of Energy contract DE-AC06-76RLO 1830.

Descriptors: *Tracers, *Tritium, *Trees, *Moisture uptake, *Groundwater, Leaves, Roots, Locust tree.

Artificially planted trees have survived for 4 decades in the very dry climate of south-central Washington without irrigation. It is generally believed that long-time tree survival depends on root contact with groundwater, but this assumption had not been critically evaluated. Leaf water from trees growing at a location where groundwater was 7.7 m below the surface had elevated levels of tritium. The well water also had elevated levels of tritium, indicating that some of the tritium measured in tree leaf water was obtained from root contact with tritiated groundwater. Tritium concentrations in leaf water were greatest in August when sources of tritium other than groundwater are least abundant, indicating that the trees relied most heavily on groundwater during the hottest and driest season of the year. (Author's abstract)
W90-00620

SOIL TEMPERATURE AND MOISTURE REGIME RELATIONSHIPS WITHIN SOME RANGELANDS OF THE GREAT BASIN.
Forest Service, Missoula, MT. Region 1.
For primary bibliographic entry see Field 2G.
W90-00639

EELGRASS PRODUCTIVITY ON AN INTERTIDAL FLAT OF CENTRAL JAPAN.
Tokai Regional Fisheries Research Lab., Tokyo (Japan).
O. Umebayashi.
Bulletin of the Tokai Regional Fisheries Research Laboratories, No. 127, p 17-30, March 1989, 2 fig, 2 tab, 33 ref.

Descriptors: *Productivity, *Eelgrass, *Plant growth, *Tidal flats, Biomass, Japan.

Quantitative estimation of eelgrass productivity was conducted in a tidal flat located in central Japan as part of a project on purification function and biotic productivity of shallow waters. Samples were collected bimonthly and were measured and analyzed chemically. An aerial survey with a multi-spectral scanner was also performed during the most active growing season of the eelgrass. Total area of the eelgrass meadow, standing stocks of biomass and each chemical component and productivity were calculated. Total area was 2,076 sq km. Standing stocks were 1,191 tons in the whole area with 478 g/sq m of aboveground and 96 g/sq m of underground per unit area. The production in the whole area was 41.59 tons/day in dry weight and per unit area was 20.52 sq m/ day or 7.5 g/sq cm/day. Comparing these results with previous reports, this tidal flat seemed a place of high productivity. (Author's abstract)
W90-00670

SOLUTE MOVEMENT THROUGH ROOT-SOIL ENVIRONMENT.
California Univ., Davis. Dept. of Land, Air and Water Resources.
J. C. Tracy, and M. A. Marino.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 608-625, August 1989. 6 fig, 2 tab, 29 ref, append. University of California, Davis and the Agricultural Research Service Cooperative Agreement 4350-H.

Descriptors: *Soil-water-plant relationships, *Crop yield, *Root zone, *Soil water, *Solute transport,

*Agricultural engineering, Water quality, Water supply, Solutes, Soil water, Transpiration, Simulation analysis, Differential equations, Boundary conditions, Mathematical studies, Finite element method, Field tests, Salts, Soil profiles.

The development of a crop and its subsequent yield are highly dependent on the quantity and quality of water available to the crop in the root zone of a soil. A methodology is developed for simulating the movement of water and solutes through a root-soil system, which accounts for the effect of the solute concentration on the extraction of soil water by a transpiring crop's root system. The resulting root-soil water flow and solute movement simulation methodology is a coupled set of partial differential equations that describe the macroscopic movement of water and solutes through a root-soil system. Potential boundary conditions are described and the methodology is solved using a Galerkin finite element method. The model is compared to field-measured soil-water content and salt concentration levels. The comparisons show an excellent agreement between simulated and measured data. The transient trend of salt concentration levels in different layers of the soil profile and the sensitivity of the salt concentration distribution in the soil profile to changes in the rooting depth of a crop could be more thoroughly analyzed with an extension of the present model to two dimensions. (Author's abstract)
W90-00885

2J. Erosion and Sedimentation

EROSION AND SEDIMENT TRANSPORT PROCESSES FOR AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Lafayette, IN.
G. R. Foster.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 111-122, 29 ref.

Descriptors: *Agricultural watersheds, *Path of pollutants, *Nonpoint pollution sources, *Erosion, *Sediment transport, *Agricultural runoff, Deposition, Sedimentation, Adsorption, Flow profiles, Gullies, Overland flow, Nonuniform flow, Rill erosion, Rainfall impact, Surface runoff, Slope degradation, Climates, Hydrology, Hydraulic properties, Cohesive soils, Watershed management.

Erosion by water is a process of detachment and transport of soil particles by raindrop impact and surface runoff. Climate and hydrology drive erosion and sediment transport by providing rainfall and surface runoff. Many factors including cover and management of the soil affect both erosivity and erodibility. A fundamental concept that is frequently used in erosion analyses is that either detachment or transport capacity may limit sediment load. Detachment limits sediment load by the amount of sediment that it makes available for transport, while transport capacity limits sediment load by the amount of sediment that flow can transport. Deposition usually occurs when transport capacity limits sediment load. Deposition is a selective process that increases the concentration of fine particles and soil adsorbed pollutants in the sediment load. Flow of field-sized areas is nonuniform across slope. Some of the nonuniformity results from tillage and some from natural irregularities. When flow erodes soil, the result is numerous, small eroded channels called rills. Areas between rills are called inter-rill areas, where soil is predominantly detached by raindrop impact. Flow on these areas is lateral toward rill areas, and its transport capacity is greatly enhanced by raindrop impact. Most downslope sediment transport is by flow in rill areas. Surface runoff within most fields collects in a few natural waterways before leaving the fields. Erosion processes occurring in these concentrated flow areas are very much like those occurring in rills. Many hydraulic concepts can be transferred from sediment transport theory for noncohesive beds in rivers to erosion processes on fields. However, nonuniformity of flow and sediment characteristics, soil cohesiveness, and the effects of cover and management cause major differences and emphasizes the need to give special consideration to erosion and sediment transport processes on fields. (See also W90-00001) (Lantz-PTT)
W90-00006

SIMULATION OF SEDIMENT YIELD FROM ALPINE WATERSHEDS.
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
G. Fleming, and S. Fattorelli.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 123-145, 11 fig, 5 tab, 20 ref.

Descriptors: *Watersheds, *Simulation analysis, *Sediment yield, *Alpine regions, *Model studies, Italy, Hydrologic models, Sediment transport, Sedimentation, Erosion, Aviso River, Brenta River.

Assessing the range of sediment yields from two river basins in the Italian Alps requires practical application of simulation techniques. Three concepts are involved: (1) the concept of treating the total water and sediment response of a river basin by simulating the dynamic interaction between the hydrology and sediment processes for the complete basin; (2) the use of the simulation technique in the development of sediment response curves for a particular basin; and (3) to apply the technique to the problem of Alpine watersheds. This problem is made more difficult than general hydrology and sediment problems due to the extreme variation in hydrological and sediment response of steep sloping torrent watersheds; the inclusion of snow accumulation and melt processes; the high level of water resource development and control; and the increasing pressure to further utilize the water and sediment resource in these areas. A river basin model, consisting of a watershed model, an erosion model, and a routing model, was applied to both the Aviso River basin, and the Brenta River basin. The most significant result from these trials was the large difference between the rate of sediment eroded in each segment due to different slope, vegetation and rainfall distribution. This emphasizes that this Alpine catchment has a greater detachment potential than it has a transportation potential to the river. This is governed by the supply of suitable sized sediment and the deposition process down-slope, and illustrates the danger of altering the physical system in any way that allows the erosion potential to be reached. (See also W90-00001) (Lantz-PTT)
W90-00007

SIMPLE MODEL FOR ASSESSING ANNUAL SOIL EROSION ON HILLSLOPES.
Silsoe Coll. (England).
R. P. C. Morgan, D. D. V. Morgan, and H. J. Finney.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 147-159, 1 fig, 5 tab, 24 ref.

Descriptors: *Soil erosion, *Model studies, *Slope degradation, *Hydrologic models, Rainfall, Runoff, Sediment transport, Slopes, Soil water, Soil properties, Evapotranspiration, Soil density, Erosion rates, Prediction, Root zone, Erosion control.

A model is presented for predicting annual soil loss from field-sized areas on hillslopes. The erosion process is separated into a water phase and a sediment phase. In the sediment phase erosion is taken to be the result of the detachment of soil particles by raindrop impact and their transport by runoff. Splash detachment is related to rainfall energy and rainfall interception by the crop. Runoff transport capacity depends upon the volume of runoff, slope steepness and crop management. Rainfall energy and runoff volume are estimated in the water phase. The predicted rate of soil loss is compared with a top soil renewal rate to determine changes in the depth of soil over time. Model validation was carried out using data from published studies of soil loss from 67 sites in twelve countries. Except for very low and very high rates of erosion, the model gives realistic predictions over a wide range of conditions. The model simulates the generation of runoff and sediment in a manner which, qualitatively at least, represents what happens in practice. The major factors which influence runoff and erosion processes (soil moisture content, bulk density of the top soil layer, top soil rooting depth, total soil depth, soil detachability index, rate of increase in soil depth by weathering at the rock-soil interface, rate of increase of the top soil rooting layer, steepness of the ground slope, annual rainfall, number of rain days/year, typical value for intensity of erosive rain, percentage rainfall contributing to permanent interception and stemflow, ratio of actual to potential evapotranspiration, crop cover management factor, and number of years for which the model is to operate) are included in a way in which the user can understand their effects and therefore decide which factors to change to ameliorate an erosion problem. The model is therefore potentially useful for reconnaissance assessments of erosion and for designing strategies for erosion control. (See also W90-00001) (Lantz-PTT)
W90-00008

SOME ASPECTS OF SOIL EROSION MODELLING.
Centro di Studio per la Genesi Classificazione e Cartografia del Suolo, Florence (Italy).
D. Torri, and M. Sfalanga.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 161-171, 2 fig, 1 tab, 39 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Nonpoint pollution sources, *Model studies, *Soil erosion, *Hydrologic models, Model studies, Agricultural runoff, Rill erosion, Mathematical models, Statistical methods, Homogeneity, Soil properties.

Soil erosion is often accelerated by agricultural activities. As sediment acts both as pollution factor and pollutant carrier, soil loss can be considered a nonpoint pollution process. An experiment on splash detachment and runoff transport shows that inter-rill erosion depends on the runoff transport capacity or on the detachment rate following which one is the limiting agent. Mathematical descriptions of these processes indicates that statistical equations are inadequate to describe inter-rill erosion. A residual variability of the data may be attributed to dishomogeneity at the soil surface (aggregate and clod distribution, crusts, etc.). This variability can induce errors in the estimate of soil loss. Consequently, it should be predicted as it can assume a relevant role when the damages due to pollution depend on critical thresholds. (See also W90-00001) (Author's abstract)
W90-00009

APPLICATION OF AN AGRICULTURAL WATER BALANCE AND EROSION MODEL IN ENVIRONMENTAL SCIENCE.
Los Alamos National Lab., NM. Environmental Science Group.
T. E. Hakonson, G. R. Foster, L. J. Lane, and J. W. Nyhan.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 173-190, 7 fig, 3 tab, 37 ref.

Descriptors: *Environmental engineering, *Landfills, *Path of pollutants, *Nonpoint pollution sources, *Erosion, *Hydrologic models, *Agricultural watersheds, *Model studies, *Agricultural hydrology, CREAMS, Arid lands, Semiarid lands, Computer models, Mathematical studies, Hydrologic budget, Succession, Agricultural chemicals, Agricultural runoff.

The use of Chemicals, Runoff, and Erosion from Agricultural Management Systems (CREAMS) in arid and semiarid rangelands and for applications to shallow land burial provides a powerful tool for

developing management alternatives for land use and waste disposal. Because CREAMS was developed primarily for cultivated agriculture and parameterized in more humid conditions in the eastern half of the United States, it is not directly applicable to arid and semiarid systems, without further development and calibration. Model parameters for CREAMS under the agricultural and environmental science applications discussed in this paper for the most part do not exist. Ongoing research by several groups and agencies is intended to rectify these deficiencies. Perhaps the greatest weakness of CREAMS, or any similar model, is the lack of structure and feedback to account for time dependent changes in physical and biological attributes of a site. Plant and animal succession, and their influence on soils, becomes important over the time scales being considered for shallow land burial (SLB) performance. Until significant advances are made in understanding, the abilities to mathematically describe ecosystem processes, models such as CREAMS will be somewhat limited in scope and utility. However, the need for tools to wisely manage natural resources will continue and represent challenges to the agricultural and environmental scientist to meet those needs. (See also W90-00001) (Lantz-PTT)
W90-00010

VALIDITY AND LIMITATIONS OF DIFFERENT TRANSPORT MODELS WITH PARTICULAR REFERENCE TO SEDIMENT TRANSPORT.
Padua Univ. (Italy). Ist. di Idraulica.
G. Di Silvio.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 191-212, 3 fig, 18 ref.

Descriptors: *Model studies, *Sediment transport, *Hydrologic models, Mathematical models, Sedimentation, Model testing, Surface flow, Groundwater movement, Comparison studies, Particle size, Mathematical equations.

The consequences of successive simplifications made on transport equations in order to obtain simpler and less detailed models are examined. More or less simplified models can be obtained by time-averaging and space-averaging performed on the transport equations. After a review of surface flow models (transport of mass and momentum) with constant density, the transport models of a neutrally buoyant tracer are discussed. Groundwater flow and groundwater tracer transport models are also considered and the approaches for modeling transport processes in stratified flows are mentioned. A survey of sediment transport models is made, stressing the effects of space and time averaging. Starting from the most general three-dimensional model of suspension, a one-dimensional unsteady model is formulated, aimed at simulating short time-scale processes both with uniform and non-uniform grainsize distribution. A quasi-steady, one-dimensional model (averaged over the hydrologic cycle) is discussed, considering first, different grainsize classes, and then all the classes altogether in the overall transport. (See also W90-00001) (Lantz-PTT)
W90-00011

SURFICIAL AND SUBSURFACE DISTRIBUTION OF AQUIFER SEDIMENTS AT THE BEMIDJI, MINNESOTA, RESEARCH SITE.
State Univ. of New York Coll. at Plattsburgh.
For primary bibliographic entry see Field 2F.
W90-00033

ASSESSMENT OF RAINFALL EROSION HAZARD.
Soil Conservation Service of New South Wales, Sydney (Australia).
K. Edwards.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 157-164, 1 tab, 22 ref.

Descriptors: *Soil erosion, *Network design, *Data collections, *Water resources data, *Erosion, *Rainfall impact, *Rainfall, Soil erosion, Model studies, Data acquisition, Hydrologic models, Soil loss.

Degradation of productive land by soil erosion is a major problem on a global basis. In developed countries, where considerable resources have been devoted to controlling the problem, there is still serious concern that much needs to be done. To aid in planning for land use it is important that the potential erosion hazard of an area be assessed. Empirical models have been developed for erosion prediction but because their nature cannot safely be extrapolated from their countries of origin. The Universal Soil Loss Equation (USLE) is the best known of these models. It includes all those factors that determine the magnitude of sheet and rill erosion and these include rainfall, soil, topographic, crop management and soil conservation factors. The rainfall utilized in the USLE is the product of the total energy of a rainstorm and the storm's maximum 30 minute intensity. To calculate this index requires long term records (20 yrs) on a continuous recording basis for individual storms. Simpler indices need to be tested or developed for wider application in developing countries. In the broader view, agro-climatic analyses need to be undertaken to allow assessment of the development of the protective canopy of various crops throughout their growth. Factors to consider are the likely chance of success of particular crops and the timing of cultivation and development of cover. Provision of data should first concentrate on providing answers to immediate problems or on providing 'best approximations' where actual data cannot be provided. The data set required for assessing rainfall erosion hazard has much in common with that required for applications in agricultural production and water resources. In developing networks, care must be taken to prevent uncoordinated action that may result in a less effective network. (See also W90-00100) (Lantz-PTT)
W90-00113

1986 LAKE POWELL SURVEY.
Bureau of Reclamation, Denver, CO. Surface Water Branch.
R. L. Ferrari.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-178818. Price codes: A04 in paper copy, A01 in microfiche. Report No. REC-ERC-88-6, December 1988. 67p, 67 fig, 6 tab, 8 ref.

Descriptors: *Reservoir silting, *Lake Powell, *Surveys, Lake sediments, Water level, Lake morphology, Sedimentation, Reservoir storage.

The 1986 Lake Powell sediment survey documented on the present storage-elevation relationship and loss of storage from sediment accumulation since the reservoir began filling in 1963. Sonic depth recording equipment mounted in a power boat was used to run the hydrographic survey. Sediment range-lines at 409 locations were established to determine the present capacity and for future monitoring of the sediment build-up. The reservoir capacity was computed based on surface areas determined by a range-line survey method. As of September 1986, at reservoir elevation 3700, the capacity was 26,214,861 acre-ft with a surface area of 160,784 acres. Since March 1963, 868,231 acre-ft of sediment accumulation have resulted in 3.2% loss in reservoir storage. (Author's abstract)
W90-00126

BLACK CREEK NO. 53, MISSISSIPPI, MAY 1983: SPILLWAY PERFORMANCE REPORT.
For primary bibliographic entry see Field 8A.
W90-00156

KENTUCKY, MAY 1984: SPILLWAY PERFORMANCE REPORT.
For primary bibliographic entry see Field 8A.
W90-00157

FLOODWATER RETARDING STRUCTURE NO. 4, MISTEGUAY CREEK, MICHIGAN: SPILLWAY PERFORMANCE REPORT FOR FLOW OF SEPTEMBER 1985.
For primary bibliographic entry see Field 8A.
W90-00158

LABORATORY DATA ON COARSE-SEDIMENT TRANSPORT FOR BEDLOAD-SAMPLER CALIBRATIONS.
Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W90-00211

STREAMFLOW, SEDIMENT TRANSPORT, AND NUTRIENT TRANSPORT AT INCLINE VILLAGE, LAKE TAHOE, NEVADA, 1970-73.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2E.
W90-00219

TRANSPORT AND SEDIMENTATION OF SUSPENDED MATTER IN OBSTRUCTED AND UNOBSTRUCTED RUNNING WATERS, (TRANSPORT-UND SEDIMENTATIONSVERHALTEN VON SUSPENSA IN UNGESTAUTEN UND GESTAUTEN FLIESSGEWAESSERN).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
M. Juraschek.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80234/GAR. Price codes: E07 in paper copy, A01 in microfiche. Contract DFG We 837/2-3, July 1986. 47p, 15 fig, 8 tab, 31 ref. English summary.

Descriptors: *Sediment transport, *Flumes, *Suspended sediments, Fluid flow, Turbulence, Sole erodability, Sedimentation.

Experimental investigations were carried out through on the uniformity and steadiness of fluid flow and transport under marginal conditions excluding sedimentation. The maximum concentration of suspended particles that can be transported in turbulent flow through a flume with a firm, plane sole without leading to sedimentation was determined and the correlation with the energy of the turbulent movement pointed out. Flow, sediment and coarseness parameters were varied within large boundaries. For the experiments aiming to determine the criteria of sedimentation a firm sole of the flume was chosen to exclude possible interaction between erosion and sedimentation. Furthermore experiments with a fully moveable sole were conducted aiming at an exemplary quantification of the basic influence of the sole's erodability and deformability on steady-state transport. (Author's abstract)
W90-00259

CONCENTRATION AND TRANSPORT OF DISSOLVED AND SUSPENDED SUBSTANCES IN THE ORINOCO RIVER.
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, and J. F. Saunders.
Biogeochemistry BIOGEP, Vol. 7, No. 3, p 203-240, May 1989. 11 fig, 4 tab, 61 ref. NSF Grants DEB8116725, BSR8315410, and BSR8604655.

Descriptors: *Solute transport, *Sediment transport, *Dissolved solids, *Suspended load, *Orinoco River, Venezuela, Colombia, Organic carbon, Ammonium, Nitrogen, Phosphorus, Wild rivers, Cycling nutrients, Erosion.

The Orinoco River, which is hydrologically unregulated and has a minimally disturbed watershed, was sampled quantitatively over a four-year interval. In conjunction with the sampling, a method was developed for quantifying statistical uncertainty in the estimates of annual transport. The discharge-weighted mean concentration of total suspended solids in the Orinoco river was 80 mg/l, which corresponds to total annual transport of 90 million ton/year, or, expressed per unit of water-

shed area, 960 kg/hectare/year, of which 96 % was inorganic. The mean for dissolved solids was 34 mg/l, of which 25 mg/l was inorganic. The total transport of inorganic material, with a small allowance for bedload was 128 million ton/year, which corresponds to an erosion rate of 4 cm/1000 year. Concentrations of dissolved and suspended constituents derived from rock weathering were very low because of dilution from high runoff (1190 mm/year), coverage of the southern part of the drainage by shield rock, and minimal watershed disturbance. Seasonal patterns in dissolved and suspended constituents were repeated with a high degree of consistency from one year to the next. The Orinoco drainage had a high specific transport of organic carbon. Concentrations of ammonium and nitrate were high. There was also a high transport rate for total nitrogen. Concentrations of soluble phosphorus were within the expected range, while concentrations of particulate phosphorus were low. (Author's abstract)
W90-00303

SOIL RESISTANCE TO EROSION IN THE SOUTHERN UKRAINE AND CHANGE THEREIN DUE TO IRRIGATION.
Odesskii Gosudarstvennyi Univ. (USSR).
G. I. Shvebs, A. A. Svetlichnyy, and S. G. Chernyy.
Soviet Soil Science SSSCAE, Vol. 20, No. 4, p 68-74, July-August 1988. 4 tab, 15 ref.

Descriptors: *Erosion control, *Soil erosion, *USSR, *Irrigation effects, *Soil stability, Soil compaction, Chestnut soils, Ukraine, Chernozem soils, Erosion, Sprinkler irrigation, Microorganisms.

Field studies of sprinkler-irrigated soils in 1981-1986 carried out at a number of operational irrigation systems in the Odessa, Nikolaybev, Kirovograd, Kherson and Crimean oblasts revealed an increase in the resistance of Chernozem and Dark Chestnut soils to erosion as a result of irrigation. Preliminary wetting, especially in fine soils, had a positive effect on the water resistance of soil aggregates. Wetting also prevented erosion due to the rapid growth of a variety of microorganisms. Another important characteristic of soil resistance to erosion was that resistance increased with increasing soil compaction. The high resistance of irrigated soils to erosion was due to a combination of these and some other factors that determine the capacity of a soil to withstand the destructive effects of water. The contribution of a given factor to a change (increase) in resistance by irrigation varies with both space and time. This clearly accounts for the wide variations in the degree of change in the resistance to erosion by irrigation of the study soils of the southern Ukraine and in the observed seasonal pattern of resistance of irrigated soils. (Mertz-PTT)
W90-00338

GLOBAL PECULIARITIES AND TENDENCIES IN RIVER DISCHARGE AND WASH-DOWN OF THE SUSPENDED SEDIMENTS: THE EARTH AS A WHOLE.
Azerbaidzhanskii Politekhicheskii Inst., Baku (USSR). Inst. of Geology.
G. P. Tamrazyan.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 113-131, March 30 1989. 4 fig, 7 tab, 16 ref.

Descriptors: *Suspended load, *Sedimentation, *Sediment discharge, *Stream discharge, *Wash load, Distribution patterns, Deposition, Global patterns.

Discharge and supply (accumulation) of sediments in river waters and suspended sediments are characterized by some global latitudinal peculiarities. The maximum discharge and supply (38.5%) of river waters falls within equatorial belts (0 + 10 degrees) as well as high-latitude boreal (50-70 degrees N and especially 70-85 degrees N) and antiboreal (30-35 degrees S) belts of the earth, which are the latitudinal foci (centers) of maximum absorption of land waters. The maximum discharge of suspended sediments (41.2%) and their supply (42.3%) to the basins of sediment accumulation is shifted to the north (10-30 degrees N) as compared to the maximum river discharge; the statistical median of this shift for the earth as a whole is about 800 km along the meridian. Between the western and eastern hemispheres of the earth exists a certain asymmetry in the river discharge and wash-down of suspended sediments. According to the median of statistic research, these discharge and supply are shifted 2100-2400 km to the north in the eastern hemisphere as compared to the western. Also, there have been established some other peculiarities of global distribution of river discharge and sediments on the earth. The latitudinal data on the wash-down of river waters and suspended sediments are integrated for the main regions of the earth (continents and Oceania). (Author's abstract)
W90-00358

HYDROLOGICAL AND SEDIMENTOLOGICAL INFLUENCES ON BOROLL CATENAS, CENTRAL SASKATCHEWAN.
Scarborough Coll., Westhill (Ontario). Dept. of Geography.
D. J. Pennock, and D. F. Acton.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 904-910, May/June 1989. 9 fig, 3 tab, 22 ref.

Descriptors: *Saskatchewan, *Sedimentation, *Geologic formations, *Soil classification, *Glaciohydrology, *Glacial soils, *Glacial drift, Soil profiles, Geomorphology, Glaciology.

The distribution of soils in a three-dimensional catena is the result of the action and interaction of hydrologic and sedimentological processes. The relative dominance of the two processes is examined at three study sites in the Black Chernozem (Udic Boroll) soil zone in central Saskatchewan by comparing the distribution of surface soils and postglacial sediments to the present slope morphology and the reconstructed paleo-slope configuration. Postglacial sedimentation was confined to convergent backslope and footslope configurations on the pale-surface and thick sola were associated with these elements. Soil characteristics on shoulder elements, divergent back slopes, and divergent footslopes were relatively unaffected by post-glacial sedimentation, and the soil characteristics in these elements were in accordance with established differences in water movement in the landscape. (Author's abstract)
W90-00387

POTENTIAL WIND AND WATER ERODIBILITY OF FOUR LAND-USE SYSTEMS IN SOUTH-EASTERN MONTANA, U.S.A.
Montana State Univ., Bozeman. Dept. of History and Philosophy.
S. G. McConnell.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 2-3, p 207-215, March 1989. 1 fig, 2 tab, 18 ref. USDA grant 82-CRSR-2-2059.

Descriptors: *Erosion, *Wind erosion, *Land use, *Montana, *Soil properties, Cropland, Erodibility, Land management.

As part of an assessment of a 1930s federal government land purchase/management program, a study was undertaken to compare the potential wind and water erodibility (as determined by soil properties) of reseeded cropland (purchased, retired and reseeded to crested wheatgrass) with abandoned cropland, cropland and native range land-use systems on a series of Haploboroll, Camborthid and Argiboroll soil great groups in south-eastern Montana. The percentage of non-wind erodible (> 0.84 mm diameter) aggregates (sampled in spring) of the surface 30 mm was greatest in cropland (85.0%), with lower values in abandoned and reseeded cropland, and native range (66.3, 66.1, and 61.4%, respectively). Permanent vegetation on the non-cropland systems probably prevented significant wind erosion. The universal soil loss equation soil erodibility factor, K, was higher (and more erodible) in cropland (0.33) and lower in the other systems (0.26, 0.25 and 0.26 for native range, abondoned and reseeded cropland, respectively). Lower organic matter and platier soil structure were primarily responsible for the higher cropland K value. Comparison of reseeded cropland and cropland suggests that reseeded cropland was more wind erobible but less water erodible (based only on a one-time soil sampling). Similarly managed (except for reseeding) abandoned cropland were not different in any property measured, suggesting no present-day effect of seeding on erosion susceptibility. The federal purchase, retirement and revegetation of these lands almost certainly reduced erosion as compared with continually cropped land, although reseeding the lands did not affect potential wind/water erodibility as compared with naturally revegetated (abandoned) cropland. (Author's abstract)
W90-00434

INFLUENCE OF PH ON STRUVITE FORMATION BY BACTERIA.
Granada Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W90-00443

ESTIMATION OF MIXING RATES IN WESTERN LAKE ONTARIO SEDIMENTS BY FINITE ELEMENT ANALYSIS OF 210PB PROFILES.
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
S. R. Joshi, and A. G. Bobba.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 195-200, May-June 1989. 4 fig, 1 tab, 19 ref.

Descriptors: *Model studies, *Tracers, *Water pollution sources, *Path of pollutants, *Mathematical studies, *Finite element method, *Sediments, *Mixing, *Lake Ontario, *Lead.

A finite element model is used to generate theoretical excess 210Pb concentration/depth profiles that are 'best-fit approximations' to directly measured profiles at five location in western Lake Ontario. The best-fit approximations are derived using a minimum error analysis technique. The results indicate that, while mixing is prevalent at all the study location, its influence is severe at locations closer to the mouth of the Niagara River. The nonoccurrence of the implicit effects of sediment mixing in measured pollutant profiles at these locations is pointed out and it is postulated that the general assumptions of constant flux of excess 210Pb and constant sedimentation rate in such models lead to unrealistic estimates of mixing. (Author's abstract)
W90-00447

GRAVEL TRANSPORT, GRAVEL HARVESTING, AND THE CHANNEL-BED DEGRADATION IN RIVERS DRAINING THE SOUTHERN OLYMPIC MOUNTAINS, WASHINGTON, U.S.A.
Washington Univ., Seattle. Dept. of Geological Sciences.
B. D. Collins, and T. Dunne.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 213-224, May-June 1989. 6 fig, 2 tab, 21 ref.

Descriptors: *Alluvial channels, *Sedimentation, *Gravel mining, *Channel erosion, *Environmental effects, *Washington, Sediment transport, Rivers, Anadromous fish, Gravel removal.

The potential for gravel extraction to adversely affect anadromous fish habitat in three gravel-bed rivers of southwestern Washington prompted the need to determine sustainable rates of gravel removal. This was accomplished by evaluating the components of a long-term sediment mass balance for the three rivers. Average annual gravel transport was determined by three independent methods: (1) bedload transport formulae, (2) bedload as percentage of suspended load, and (3) measured rates of bank erosion and bar accretion at individual bends. The closely agreeing results indicate that annual bedload supply decreases downstream through deposition and storage in response to de-

clining gradient and from attrition during transport, as confirmed by laboratory experiments. A survey of gravel-bar harvesting operations indicates that the annual replenishment rate has been exceeded for up to three decades, often by more than tenfold. Analysis of data from nine stream gauging stations over a 55-yr period indicates that bed degradation has produced the difference between the replenishment rates and the volumes of gravel harvested from the river beds and bars. (Author's abstract)
W90-00449

APPARATUS FOR THE IN-SITU DETERMINATION OF PHYSICO-CHEMICAL PARAMETERS ACROSS THE SEDIMENT-WATER INTERFACE.
ENEA, La Spezia (Italy). Centro Richerche Energia Ambiente.
For primary bibliographic entry see Field 7B.
W90-00504

STUDY OF THE SEDIMENTOLOGICAL AND RHEOLOGICAL PROPERTIES OF FLUID MUD IN THE FLUVIO-ESTUARINE SYSTEM OF THE GIRONDE ESTUARY.
Direction de l'Amenagement et de l'Environnement, Bordeaux (France).
J. Granboulan, A. Feral, and M. Villerot.
Ocean & Shoreline Management, Vol. 12, No. 1, p 23-46, 1989. 12 fig, 13 ref.

Descriptors: *Sediment transport, *Mud, *France, *Estuaries, *Navigation, *Sediment-water interfaces, *Mud-water interfaces, *Measuring instruments, Fluid mud, Water currents, Tidal currents, Clays, Salinity, Interstitial water, Measuring probes.

A fifteen year study was carried out in the Gironde estuary in order to gain information on the characteristics of the complex fluid mud environment and to provide a rapid assessment of the variations in concentration within the fluid mud layer. The Gironde fluvio-estuarine system is influenced by major sedimentary movements caused by the combined action of the tidal currents and the flow (both liquid and solid) from the two rivers, the Garonne and the Dordogne. The fluid mud is essentially composed of clays (< 2 microm) and medium to fine silts (20-2 microm), and is fairly uniform throughout the estuary. On a longitudinal scale, for a given epoch, the fluid mud remains stable. Granulometrically, lithologically and mineralogically, it does not vary significantly. This is not the case, however, on a seasonal scale, nor on a reduced time scale (i.e. a decade). The variations involve the dimensional characteristics, the contents of quartz, of clays, and the composition of the argillaceous contents. The study of the salt content of the interstitial waters of the fluid mud showed that salinity could be a good indicator of this sediment. In fact, determining the salinity is essential for correcting the estimates of the content of dry sediment, as well as for interpreting the results of the rheological tests. A general provisory relationship between the initial rigidity and the concentration was established for the fluid mud in the Gironde estuary. This enabled the development of an ultrasonic probe for sedimentary measurements, which can operate in the dynamic mode and measure the concentration in the fluid mud layer. This probe has been used for operation of the navigation channel. (White-Reimer-PTT)
W90-00518

WEATHERING RATES AND SR87/SR86 RATIOS: AN ISOTOPIC APPROACH.
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
For primary bibliographic entry see Field 2K.
W90-00578

VELOCITY REDISTRIBUTION IN MEANDERING RIVERS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W90-00627

MECHANICS OF OVERFLOW EROSION ON EMBANKMENTS: I. RESEARCH ACTIVITIES.
Bureau of Reclamation, Denver, CO.
G. R. Powledge, D.C. Ralston, P. Miller, Y. H. Chen, and P. E. Clopper.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1040-1055, August 1989. 4 fig, 3 tab, 13 ref.

Descriptors: *Bank erosion, *Erosion control, *Flood protection, *Overflow, *Embankments, *Hydraulic engineering, Spillways, Flood control, Flood forecasting, Engineering, Great Britain.

Model and prototype research studies have been conducted in the United States and Great Britain to evaluate how embankments for dams, levees, roadways, etc. perform when subjected to overtopping flows from probable maximum flood (PMF) or near-PMF events. With improvements in the collection of flood records and the development of estimated storm events a significant increase in predicted PMF has been realized in some areas of the United States and other countries. These studies provide the engineer with an understanding of the mechanics of overflow erosion through subjecting scale model and prototype embankments to overtopping flow events. The effectiveness of various protection systems in preventing overflow erosion is evaluated. These systems range from grass-lined embankments and spillways to more sophisticated protection using geotextiles, gabions, riprap, cellular concrete blocks and soil cement. Such research efforts provide for the development of cost-effective measures that allow embankments to pass these extreme flood events without breaching. (Author's abstract)
W90-00628

MECHANICS OF OVERFLOW EROSION: II. HYDRAULIC AND DESIGN CONSIDERATIONS.
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 8B.
W90-00629

COHESIVE SEDIMENT TRANSPORT: I. PROCESS DESCRIPTION.
Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
A. J. Mehta, E. J. Hayter, W. R. Parker, R. B. Krone, and A. M. Teeter.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1076-1093, August 1989. 2 fig, 2 tab, 57 ref, append.

Descriptors: *Cohesive sediments, *Sediment transport, *Deposition, *Estuaries, Numerical analysis, Erosion, Advection, Cohesion, Tides, Settling velocity, Field tests, Bed load, Cohesion.

As a consequence of complexities due to the oscillatory nature of tidal flows and associated cycles of erosion and deposition, modeling of cohesive sediment transport in many cases is carried out via solution of the advection-dispersion equation of sediment mass conservation using numerical techniques. Physical processes constituting fine, cohesive sediment transport in estuarial waters, including settling and deposition, consolidation, erosion and transport in suspension, are typically interlinked by the cyclic nature of the tide-dominated environment. Data collection efforts in field investigations for prediction of deposition or erosion are therefore guided by the need to provide input to numerical models. Further research is required for improving procedures for measuring settling velocities, identification of depth at which a definable bed is encountered, and the behavior of near-bed high density supplement. (Fish-PTT)
W90-00630

COHESIVE SEDIMENT TRANSPORT: II. APPLICATION.
Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
For primary bibliographic entry see Field 2L.
W90-00631

NATURAL VARIATIONS IN NITROGEN-15 CONTENT OF RIVERINE AND ESTUARINE SEDIMENTS.
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 2L.
W90-00680

SUCCESSIONAL CHANGES IN HABITAT CAUSED BY SEDIMENTATION IN NAVIGATION POOLS.
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik, and J. R. Adamas.
Hydrobiologia HYDRB8, Vol. 176/17, p 17-27, July 3, 1989. 8 fig, 3 tab, 11 ref.

Descriptors: *Sedimentation, *Rivers, *Navigation canals, *Succession, *Environmental effects, *Limnology, *Silting, *Mississippi River, Missouri, Scour, Habitats.

Upstream of St. Louis, Missouri, navigation on the Upper Mississippi River is made possible by a series of lock and dam structures. Many of the pools formed by these navigation dams have nearly reached a new equilibrium condition for scour and deposition of sediment. Several pools with extensive backwater or channel border areas are still accumulating sediment at rates similar to those for man-made lakes. The original open-water habitats in these pools are changing to aquatic macrophyte beds and then to marsh or terrestrial floodplain conditions because of sediment deposition. Two pools are used as examples of this phenomenon. Pool 19 on the Mississippi River was formed when the lock, dam and powerhouse at Keokuk, Iowa were completed in 1913. Peoria Lake has been affected by the diversion of Lake Michigan water into the Illinois River in 1900 and the construction of a lock dam in 1939. Both pools have had well over 50% of their original volume filled with sediment. three areas in Pool 19 illustrate the successional changes that occur as sedimentation raises the river bottom into the photic zone. Sedimentation has made boating impossible on large areas of both pools. The continuing process is likely to change open waters to floodplains. Peoria Lake lacks aquatic plant beds because of excessive turbidity and frequent resuspension of bed material by wind-, or boat-generated waves. It seems likely these rivers reaches will become a narrow channel without any broad and highly productive channel borders. (Author's abstract)
W90-00697

ENTRAINMENT OF SEDIMENTS BY THE TURBULENT FLOW OF WATER.
Sydney Univ. (Australia). School of Civil and Mining Engineering.
L. W. Apperley, and A. J. Raudkivi.
Hydrobiologia HYDRB8, Vol. 176/17, p 39-49, July 3, 1989. 11 fig, 5 ref.

Descriptors: *Sediment transport, *Alluvial channels, *Sedimentation, *Entrainment, *Turbulent flow, *Velocity, Channels, Longitudinal force, Lift force, Lateral force.

The role of fluid turbulence in the entrainment process of particles from the flat bed of an alluvial channel is clarified. A 6 mm diameter sphere, placed in an array of similar particles on the bed of a laboratory flume, was connected to a 3-component force transducer. Dynamic measurements of longitudinal, lift and lateral force components were made with the particle at a number of positions above the bed. Detailed measurements of velocity and turbulence were also made. The velocity and force spectral measurements showed similarities in the longitudinal (streamwise) direction but the lift force component spectra were significantly different. An analytical model of the entrainment process is proposed, in which the impulse required to lift a sediment particle from the channel bed may be calculated. The experimental data has been used to evaluate the constants in the analytical expressions, and a relationship between the forces and turbulence intensity established. The analysis shows that the impulse required to entrain a particle may be expressed as a function of a dimension-

less entrainment parameter, the turbulence intensity, and the initial angle of repose of the particle. (Author's abstract)
W90-00699

HYDRO-SEDIMENTOLOGY OF THE JOHNSTONE RIVER ESTUARY.
Queensland Inst. of Tech., Brisbane (Australia). Dept. of Applied Geology.
For primary bibliographic entry see Field 2L.
W90-00700

SEDIMENT TRANSPORT IN AN INLAND RIVER IN NORTH QUEENSLAND.
Queensland Water Resources Commission, Brisbane (Australia).
W. A. Poplawski, J. Piorewicz, and M. R. Gourlay.
Hydrobiologia HYDRB8, Vol. 176/17, p 77-92, July 3, 1989. 10 fig, 5 tab, 21 ref.

Descriptors: *Sediment transport, *Suspended sediments, *Rivers, *Particulate matter, *Particle size, *Australia, Inland rivers, Numerical analysis.

A possible approach to predicting sediment loads in rivers in northern Queensland, Australia is outlined. Suspended sediment samples have been analyzed to give both particulate concentrations and their grain size distributions. The latter may have been compared with bed material size distributions, and the concentrations of suspended bed material and wash load components have been estimated. After investigations of a number of methods for predicting bed material transport, those which treat bed load and suspended load independently have been selected. Field data have been used to determine the wash load and the suspended bed material load. The bed load was then computed so that total sediment load could be determined. None of the methods discussed can be recommended as more accurate that the others. Moreover, it can generally be concluded that it is almost impossible to predict the bed material load with an accuracy better than a factor of 2. Therefore, application of simple approximation functions is preferred to avoid complicated numerical methods. When the wide variability of the wash load from flood depending upon catchment conditions is considered, the possible discrepancy factor between actual and computed total sediment load could be considerably greater than 2. (Miller-PTT)
W90-00702

SEDIMENT DISPERSION: PART I. FINE SEDIMENTS AND SIGNIFICANCE OF THE SILT/CLAY RATIO.
Canada Centre for Inland Waters, Burlington (Ontario).
P. G. Sly.
Hydrobiologia HYDRB8, Vol. 176/17, p 99-110, July 3, 1989. 8 fig, 1 tab, 20 ref.

Descriptors: *Dispersion, *Sediment transport, *Sedimentation, *Sediments, *Sand, *Silt, *Clays, *Bottom sediments, *Sediment sorting, Fine sediments, Particle size.

Bottom sediment texture is related to dispersion by means of simple particle-size characteristics and the possibility of characterizing a sedimentary environment by limited sediment textural information is examined. The Great Lakes data indicate that silt/clay ratios are not unique to a specific sample mean particle-size. As an indicator of sedimentary conditions, they must be coupled with sample mean size or, at least, sand composition data. Pelletiers' data and those from the Great Lakes both show that, at mean size finer than about 2 phi, there is a direct relationship between the silt/clay ratios and mean size. However, the silt/clay ratio does not decline consistently with mean particle-size. There appears to be no relationship between the silt/clay ratio and the particle-size distribution of bottom sediments, where bed materials are composed of sand or coarser sediment. The greatest variation in silt/clay ratios is associated with samples dominated by silts. In areas of rapid and fluctuating deposition, the lack of temporal and spatial resolution imposed by sample (depth) integration may exacerbate such variations. Silt/clay ratios are likely to be locally similar under relatively high energy conditions; at such sites, they may reflect composition of the suspended load rather than the deposition of some fraction of it. Silt/clay ratios are most comparable in deepwater (limited circulation) environments subject to low rates of fine silt and clay accumulation. Relationships between silt/clay ratios and sediment mean particle-size in marine and non-marine environments share many similarities. (Miller-PTT)
W90-00704

SEDIMENT DISPERSION: PART II. CHARACTERIZATION BY SIZE OF SAND FRACTION AND PERCENT MUD.
Canada Centre for Inland Waters, Burlington (Ontario).
P. G. Sly.
Hydrobiologia HYDRB8, Vol. 176/17, p 111-124, July 3, 1989. 7 fig, 1 tab, 17 ref.

Descriptors: *Dispersion, *Sedimentation, *Sediments, *Sediment transport, *Sand, *Mud, *Sludge, *Sediment sorting, Scour.

The use of sands and muddy sediments as a means of substantiating dispersal of both naturally derived and introduced materials is examined using examples drawn from the River Mersey and Liverpool bay that illustrate the use of simple statistical parameters to describe dispersion of sands and muddy sediments. The River Mersey and Liverpool Bay, eastern Irish Sea, were sites of intensive studies on the dispersal of dumped harbour mud and sewage sludge during the mid 1960s-70s. The combined effects of strong tidal scour, wave action and shoreland near-bed residual drift result in shoreward transport of large volumes of sand in the bay. Large amounts of mud (silt/clay mixtures) oscillate in the river estuary, and naturally derived and dumped muds also move shoreward in the bay. Unpublished historic geochemical data have been combined with reprocessed particle size data and both have been used to reassess sedimentological techniques for defining transport and dispersal pathways. River and bay muds have similar size compositions, but river muds have excess Cd > V > U > As + Zn relative to bay muds. The lower relative concentrations of heavy metals in the bay are thought to reflect desorption and degradation of organic matter from the river. Trends in sediment distribution data based on the means of the sand size fraction alone, provide sensitivities comparable to those of higher order moment measures and are usually easier to interpret than full size spectrum analyses. (Author's abstract)
W90-00705

PARTICLE SIZE CHARACTERISTICS OF FLUVIAL SUSPENDED SEDIMENT: AN OVERVIEW.
Exeter Univ. (England). Dept. of Geography.
D. E. Walling, and P. W. Moorehead.
Hydrobiologia HYDRB8, Vol. 176/17, p 125-149, July 3, 1989. 17 fig, 4 tab, 51 ref.

Descriptors: *Sediments, *Sediment transport, *Suspended sediments, *Particle size, *Fluvial sediments, Erosion, Spatial variability.

Existing knowledge of the physical properties involved in fluvial transport are reviewed and several of the uncertainties involved are highlighted. Any attempt to understand the precise relationship between the grain size characteristics of suspended sediment and those of its source material must also take account of the selectivity of erosion and delivery processes. A local case study undertaken in the 1500 sq km basin of the River Exe in Devon (England) is used to illustrate the considerable spatial variability that may occur within a relatively small area and the complexity of the associated controls. Available evidence concerning the temporal variability of the grain size characteristics of suspended sediment emphasizes the diverse patterns of behavior that may exist and the complexity of the controls involved. In some rivers, the sediment may become coarser as the flow increases; in others it may become finer or exhibit a relatively constant grain size composition. Data from the local case study in the Exe basin are again used to highlight the considerable diversity in response to changing discharge that may occur within a relatively small area. Any attempt to understand the dynamics of sediment movement through a river system must also take account of the potential contrast between the ultimate and effective particle size distribution of suspended sediment in response to aggragation. Results from the Exe basin study indicate that even in rivers with relatively low solute concentrations, almost an order of magnitude difference may exist between the median particle size associated with the ultimate and effective grain size distributions. (Author's abstract)
W90-00706

ENVIRONMENTAL INVESTIGATION OF A MARINE COASTAL AREA: GULF OF GAETA (TYRRHENIAN SEA).
ENEA, La Spezia (Italy). Centro Richerche Energia Ambiente.
For primary bibliographic entry see Field 2L.
W90-00709

CAN WE DETERMINE THE BIOLOGICAL AVAILABILITY OF SEDIMENT-BOUND TRACE ELEMENTS.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W90-00726

SIMULATION OF THE PROCESS OF SEDIMENTATION OF SUSPENDED SOLIDS IN THE YOSHII RIVER ESTUARY.
National Research Inst. for Pollution and Resources, Yatabe (Japan).
K. Nakata.
Hydrobiologia HYDRB8, Vol. 176/17, p 431-438, July 3, 1989. 6 fig, 4 ref.

Descriptors: *Sedimentation, *Suspended solids, *Estuaries, *Japan, *Simulation, Yoshii River Estuary, Model studies, Particle size, Dynamic processes.

Relationships between dynamic processes and the behavior of suspended solids in the Yoshhi River estuary are demonstrated through numerical modelling applications. A vertical plane 2-dimensional model was applied to the Yoshii River estuary (Japan) as a means of simulating the process of sedimentation. The current velocity and isohaline distributions were well-reproduced in the estuary and the model simulated the concentration distribution of suspended solids for 8 particle size classes by using a transport equation based only on physical processes. The changes of the particle size distribution in surface water were well reproduced by the model. The vertical velocity component plays an important role in the behavior of suspended solids. In the surface waters of this estuary, changes in the particle size spectra at a size less than 15 microm can be largely explained by the influence of physical processes. The vertical component is extremely important in this estuary. This component depends on the amount of freshwater inflow, tidal amplitude and bottom topography. (Miller-PTT)
W90-00730

SEDIMENT SAMPLING EVALUATED WITH A NEW WEIGHTING FUNCTION AND INDEX OF RELIABILITY.
Uppsala Univ. (Sweden). Naturgeografiska Inst.
For primary bibliographic entry see Field 7B.
W90-00732

USE OF TURBIDIMETERS IN SUSPENDED SEDIMENT RESEARCH.
University Coll., Campbell (Australia). Dept. of Geography and Oceanography.
For primary bibliographic entry see Field 7B.
W90-00733

SEDIMENT TRAP ASSEMBLAGES-A METHODOLOGICAL DESCRIPTION.

Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 7B.
W90-00734

SENSITIVE SCREENING BIOASSAY TECHNIQUE FOR THE TOXICOLOGICAL ASSESSMENT OF SMALL QUANTITIES OF CONTAMINATED BOTTOM OR SUSPENDED SEDIMENTS.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 7B.
W90-00736

POTENTIAL IN FLUVIAL GEOMORPHOLOGY OF A NEW MINERAL IDENTIFICATION TECHNOLOGY (QEM*SEM).
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 7B.
W90-00737

ADSORPTION AND RELEASE OF PHOSPHATE FROM SEDIMENTS OF A RIVER RECEIVING SEWAGE EFFLUENT.
Southern Water Authority, Chatham (England). Kent Div.
For primary bibliographic entry see Field 5B.
W90-00829

ORGANIC MARKERS AS SOURCE DISCRIMINANTS AND SEDIMENT TRANSPORT INDICATORS IN SOUTH SAN FRANCISCO BAY, CALIFORNIA.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W90-00854

MODIFICATION OF BEDLOAD TRANSPORT CAPACITY IN BRAIDED RIVERS (NOTE).
T. R. H. Davies.
Journal of Hydrology (New Zealand), Vol. 27, No. 1, p 69-72, 1988. 2 fig, 4 ref.

Descriptors: *Alluvial channels, *Bed load, *Bedload discharge, *River flow, *Sediment transport, *Braided streams, New Zealand, Mathematical equations, Flow curves.

The capacity of a river to transport bedload sediment correlates well with the excess specific stream power, grain size and flow depth. Using these relationships it is possible to mathematically describe bedload transport in braided rivers over a long period of time. Using the flow duration curve of the Rakaia River, Canterbury, New Zealand for the braided portion, it was determined that the flow rate most effective in moving bedload sediment is about 800 cu m/sec. This value is considered the 'dominant' discharge although the flatness of the curve indicates the dominance is indistinct. If water is abstracted from the river at a rate which varies in time, the modification to the flow duration curve resulting from this abstraction can be calculated and the result is a different set of probabilities. The percentage reduction in bedload transport capacity due to the abstraction can then be calculated by comparing the areas under the natural and modified flow curves. This comparative approach has the merit of allowing the relative effects of various river management strategies to be assessed; for example, the effect of abstracting only water required for proposed irrigation schemes can be calculated. (White-Reimer-PTT)
W90-00936

EXPERIMENTS ON SEDIMENT TRANSPORT IN SHALLOW FLOWS IN HIGH GRADIENT CHANNELS.
Clemson Univ., SC. Dept. of Civil Engineering.
N. M. Aziz, and D. E. Scott.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 465-478, August 1989. 5 fig, 5 tab, 11 ref.

Descriptors: *Model studies, *Channel morphology, *Sediment transport, *Channel flow, *Hydraulic gradient, *Hydraulic models, *Urban runoff, Construction runoff, Agricultural runoff, Torrents, Hydraulic roughness, Particle size, Regression analysis.

An experimental study relates to the transport of sediment under certain conditions not typical of river sedimentation studies. The study of sediment transport in general lacks information on sediment moving down high gradient channels typical of streets, construction sites, agricultural land, and mountain torrents. Transport of non-cohesive sediment in high gradient channels includes determination of the transport capacity of shallow flows in high gradient channels with simulated bed roughness and various grain sizes was studied in flume models. Regression analysis performed to relate the dependent and independent variables in function relationships revealed good correlation. (Author's abstract)
W90-00942

SOURCE AREAS, DRAINAGE DENSITY, AND CHANNEL INITIATION.
California Univ., Berkeley. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W90-00955

MANAGEMENT EFFECTS ON RUNOFF, SOIL, AND NUTRIENT LOSSES FROM HIGHLY ERODIBLE SOILS IN THE SOUTHERN PLAINS.
Southern Plains Range Research Station, Woodward, OK.
W. A. Berg, S. J. Smith, and G. A. Coleman.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 5, p 407-410, Sep-Oct 1989. 2 fig, 2 tab, 8 ref.

Descriptors: *Soil erosion, *Land management, *Nutrients, Agricultural watersheds, Range management, Runoff.

The effect of management on runoff, sediment yield, and associated N and P losses from highly erodible soils on the Rolling Red Plains of western Oklahoma was determined. Flumes and automatic samplers were installed on watersheds dominated by Quinlan and Woodward loams (Typic Ustocrepts, T values 4.5 and 6.7 Mg ha -1 yr-1 (2 and 3 tons/acre/year), respectively). Two rangeland watersheds yielded on annual average of 1.3 cm (0.5 inch) of runoff and 0.4 Mg/ha (0.18 ton/acre) sediments over the period 1977-1986. Two adjacent watersheds, initially in range, were plowed in 1979 and farmed by conventional cultivation or conservation tillage for wheat grain (1980-1984) or grass-out wheat forage (1985-1986). Runoff and sediment yields from the farmed watersheds were low, similar to those from rangeland, through 1984. Major rainstorms (return period 1 in 8 or 9 years) in late summer or early fall in 1985 and 1986 eroded an average of 68 Mg ha-1yr-1 (30 tons/acre/year) of sediment from the conventionally cultivated watershed, 3 Mg ha-1yr-1 (1.3 tons/acre/year) from the watershed under no-till management, and 0.3 Mg ha-1-yr-1 (0.13 tons/acre/year) from the range watersheds. Runoff over the 1985-1986 period averaged 13, 13, and 1 cm/yr (5, 5, and 0.4 inches) from the conventionally cultivated, no-till, and range watersheds, respectively. Thus, no-till management controlled erosion within acceptable limits on highly erodible grazeout wheatland. However, use of no-till management on wheatland in the Rolling Red Plains is limited by cost and an inability to control cool-season annual grasses in wheat grown for grain. (Author's abstract)
W90-00959

2K. Chemical Processes

CLAY MINERALOGY OF SEDIMENTS ASSOCIATED WITH A PLUME OF CREOSOTE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
M. W. Bodine.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p A9-A15, 8 fig, 1 tab, 5 ref.

Descriptors: *Sediments, *Path of pollutants, *Clays, *Mineralogy, Groundwater pollution, Creosote, Chemical analysis, Iron oxide, Smectite, Geology, Chemical properties, Plumes, Florida, Geochemistry, Pyrite, Sand, Geologic history.

This study characterizes the clay minerals in sediments associated with a plume of creosote-contaminated groundwater. The plume of contaminated groundwater near Pensacola, FL, is in shallow, permeable, Miocene to Holocene quartz sand and flows southward toward Pensacola Bay. Clay-size fractions were separated from 41 cores, chiefly split-spoon samples at 13 drill sites. The most striking feature of the chemical analyses of the clay fractions from uncontaminated site 2 and contaminated sites 4,5,6, and 7 is the variability of iron oxide (species in some samples as Fe_2O_3); total iron oxide abundance is lowest (2.5%) in uncontaminated sample 2-40, but is $>$ 4.5% (4.5 to 8.5%) in the remaining assemblages. One feature suggesting interaction between the indigenous clays and the waste plume is the presence of nontronite-rich smectite. Nontronite commonly has been identified as the product of hydrothermal alteration and deep-sea weathering of submarine basalts; it is not a common constituent of Cenozoic Gulf Coast sediments. At the Pensacola site, relatively abundant nontronitic smectite is confined to contaminated sands or associated muds; it is least abundant or absent in sands and muds peripheral to the waste plume. The geochemistry of the waste plume, its substantial dissolved, (chiefly ferrous iron), mildly acidic (pH 5-6), and low redox composition, provides an environment similar to that previously determined for the low-temperature synthesis of nontronite. Data from clay-size fractions confirm conclusions that neoformed pyrite in some grain coatings occurs in an assemblage with excess iron over that required in the pyrite. Continuing studies to evaluate these tentative conclusions include: (1) chemical analysis of clay fractions from remaining sites to further examine the apparent relation between iron content and abundance of nontronitic smectite; (2) clay separation and analysis, and pore fluid extraction (squeezing or ultracentrifugation) and analysis from a continuous core through the mud lens to determine pore fluid composition (presence or absence of waste fluid), and character of associated clay minerals; and (3) clay separation and analysis in both permeable sands and the intervening mud lens that are clearly outside the limits of the waste plume to further document the effects of the plume. (See also W90-00022) (Lantz-PTT)
W90-00023

GEOCHEMISTRY OF A SHALLOW AQUIFER CONTAMINATED WITH CREOSOTE PRODUCTS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00024

DETERMINATION OF THE RATES OF ANAEROBIC DEGRADATION OF THE WATER-SOLUBLE FRACTION OF CREOSOTE.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W90-00026

MASS TRANSFER AT THE ALKANE WATER INTERFACE IN LABORATORY COLUMNS OF POROUS MEDIA.
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W90-00037

MINE-WATER DISCHARGE, METAL LOADING, AND CHEMICAL REACTIONS.
Geological Survey, Oklahoma City, OK.

For primary bibliographic entry see Field 5B.
W90-00039

GEOHYDROLOGIC SETTING OF THE MIAMI WASH-PINAL CREEK ACIDIC GROUNDWATER STUDY AREA NEAR GLOBE, ARIZONA.
Geological Survey, Tucson, AZ.
For primary bibliographic entry see Field 2F.
W90-00042

NEUTRALIZATION OF ACIDIC GROUND WATER IN EASTERN ARIZONA.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-00043

ARSENIC IN AN ALLUVIAL-LACUSTRINE AQUIFER, CARSON DESERT, WESTERN NEVADA.
Geological Survey, Carson City, NV.
A. H. Welch, and M. S. Lico.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p E13-E18, 3 fig, 15 ref.

Descriptors: *Lake sediments, *Deserts, *Nevada, *Arsenic, *Alluvial aquifers, *Geochemistry, *Groundwater quality, Path of pollutants, Fate of pollutants, Chemical reactions, Aquifers, Saline water, Iron, Manganese, Hydrogen ion concentration, Desorption, Oxides.

Studies of naturally occurring arsenic in groundwater indicate that arsenic exists primarily as an hydroxyanion, either as an oxidized (arsenate) or a reduced (arsenite) species. One site selected for study is 90 km east of Reno, NV, in the arid Carson Desert near Fallon, NV. It is underlain by alluvial-lacustrine deposits and is referred to here as the Dodge Ranch site. The quality of groundwater at Dodge Ranch ranges from a dilute type (about 550 mg/L dissolved solids) dominated by calcium and bicarbonate to a moderately saline water (> 10,000 mg/L) dominated by sodium and chloride. Large changes in As concentration--over 2 orders of magnitude--take place within a lateral distance of only 200 m. Processes that appear to be associated with high As concentrations in the groundwater at Dodge Ranch are: (1) dissolution of ferric oxyhydroxide; (2) dissolution of manganese oxides; (3) evapotranspiration; (4) oxidation of sedimentary organic matter; and perhaps (5) desorption. Field and laboratory studies have led other investigators to conclude that adsorption on ferric oxyhydroxide (and perhaps smectite) can control concentrations of As. Laboratory studies suggest that arsenate adsorption is pH-dependent. Thus, the fairly high pH of the water at Dodge Ranch (about 7.8 to 9.2), along with As concentrations above 0.4 mg/L and high concentrations of phosphate (about 1 to 9 mg/L as P), are favorable conditions for desorption of As. As adsorption may, however, be a non-equilibrium process, thus the release of As may require the dissolution of the oxides. (See also W90-00022) (Lantz-PTT)
W90-00045

HYDROGEOCHEMISTRY OF URANIUM AND ASSOCIATED ELEMENTS AT ABANDONED URANIUM MINES IN WESTERN NORTH DAKOTA.
Geological Survey, Bismarck, ND.
For primary bibliographic entry see Field 5B.
W90-00046

MODELING SORPTIVE PROCESSES IN LABORATORY COLUMNS.
Geological Survey, Lakewood, CO. Water Resources Div.
D. B. Grove.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 79-81, 1 ref.

Descriptors: *Model studies, *Sorption, *Path of pollutants, Solute transport, Computer programs, Chemical reactions.

A common type of chemical reaction that occurs during the movement of solutes in porous media is sorption of the solute onto the solid surface through a physical attraction or an exchange process. This paper describes sorption isotherms, discusses the shapes and significance of different slopes, and describes equations used to evaluate the slopes of isotherms. Computer programs can be used to compute concentrations of the effluent from a laboratory column and the concentration profile within the column. (See also W90-00052) (Lantz-PTT)
W90-00058

ROLE OF COMPLEXATION AND ADSORPTION PROCESSES IN TOXIC METAL TRANSPORT.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00062

INDIANA WATER QUALITY 1987: MONITOR STATION RECORDS, RIVERS AND STREAM.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN.
For primary bibliographic entry see Field 5B.
W90-00079

GEOCHEMICAL INTERACTIONS OF HAZARDOUS WASTES WITH GEOLOGICAL FORMATIONS IN DEEP-WELL SYSTEMS.
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W90-00141

QUALITY OF GROUND WATER IN IDAHO.
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W90-00202

AQUEOUS GEOCHEMISTRY OF THE MAGOTHY AQUIFER, MARYLAND.
Geological Survey, Idaho Falls, ID.
L. L. Knobel, and S. W. Phillips.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2323, 1988. 28p, 12 fig, 4 tab, 37 ref.

Descriptors: *Geochemistry, *Maryland, *Magothy Aquifer, *Groundwater movement, Groundwater quality, Groundwater recharge, Aquifers, Sodium bicarbonate, Chemical reactions, Oxygen, Carbon dioxide.

The Upper Cretaceous Magothy Formation of the Atlantic Coastal Plain is a seaward-dipping strand zone deposit of fluviomarine origin that crops out in an irregular belt in Maryland. Region I contains the outcrop of the formation. Groundwater in this region is derived from precipitation on the outcrop and is characterized by dissolved calcium, bicarbonate, sulfate, and iron. These ions are the products of reactions among H2O, CO2, 02, and minerals in the aquifer; these reactions include incongruent dissolution of potassium feldspar, plagioclase, and mica, oxidation of pyrite, and oxidation-reduction reactions involving lignite and dissolved iron and sulfur species. The groundwater in Region I travels relatively short distances (< 30 mi) and discharges into Chesapeake Bay and its tributaries. Region II is underlain by the buried Magothy aquifer; the sole source of water to the recharge area of the Magothy aquifer in this region is downward leakage of calcium bicarbonate water from the Aquia aquifer. Dissolved CO2 and O2, commonly associated with recharge from atmospheric precipitation, react with minerals in the Aquia aquifer and are consumed before reaching the Magothy aquifer. As water moves downgradient, calcium replaces sodium on clay-mineral exchange sites and the water takes on a sodium bicarbonate character. In the downgradient part of Kegion II where CO2 is added to groundwater by anaerobic microbial activity, carbonate dissolution may occur; however, dissolution of silicate minerals is more likely. Groundwater in this region travels relatively long distances (up to 50 mi) and discharges through upward leakage into overlying units. (Author's abstract)
W90-00223

GEOCHEMICAL EVOLUTION OF AQUEOUS SODIUM IN THE BLACK CREEK AQUIFER, HORRY AND GEORGETOWN COUNTIES, SOUTH CAROLINA.
A. Zack, and I. Roberts.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2324, 1988. 15p, 18 fig, 1 tab, 19 ref.

Descriptors: *Geochemistry, *Black Creek Aquifer, *Groundwater quality, *South Carolina, *Saline water intrusion, Sodium, Chlorides, Calcium carbonate, Calcium, Chemical reactions, Seawater, Clays, Soil chemistry.

The Black Creek aquifer contains dilute seawater near the North Carolina State line, probably the result of incomplete flushing of ancient seawater. Data do not indicate that the dilute seawater has migrated toward areas of fresh groundwater withdrawals. The concentration of chloride in groundwater samples ranges from 5 to 720 mg/L and that of sodium from 160 to 690 mg/L. Ion exchange reactions (sodium for calcium and fluoride for hydroxyl) occur with the calcium carbonate dissolution reaction produces calcium, bicarbonate, and hydroxyl ions. The reaction sequence and stoichiometry result in an aqueous solution in which the sum of bicarbonate and chloride equivalents per liter is equal to the equivalents per liter of sodium. Calcium ions are exchanged for sodium ions derived from sodium-rich clays upgradient of the dilute seawater. The cation-exchange reaction equilibrates at a sodium concentration of 280 mg/L. Amounts of sodium > 280 mg/L are contributed from dilute seawater. The cation-exchange reaction approaches an equilibrium which represents a mass-action limit in terms of the ratio of sodium to calcium in solution versus the ratio of exchangeable sodium to calcium on clay surfaces. Where the limit of calcium carbonate solubility is approached and dissolution ceases, some precipitation of calcite probably takes place. The dissolution of calcite exposes fossil shark teeth which release fluoride ions to the groundwater through anion exchange with aqueous hydroxyl ions. (Author's abstract)
W90-00224

RUBIDIUM DETERMINATION IN MINERAL AND THERMAL WATERS BY ATOMIC-ABSORPTION SPECTROMETRY.
For primary bibliographic entry see Field 7B.
W90-00296

METHANOGENESIS AND MICROBIAL LIPID SYNTHESIS IN ANOXIC SALT MARSH SEDIMENTS.
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W90-00302

CONCENTRATION AND TRANSPORT OF DISSOLVED AND SUSPENDED SUBSTANCES IN THE ORINOCO RIVER.
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2J.
W90-00303

CHEMICAL COMPOSITION AND NUTRIENT LOADING BY PRECIPITATION IN THE TRACHYPOGON SAVANNAS OF THE ORINOCO LLANOS, VENEZUELA.
Universidad Simon Bolivar, Caracas (Venezuela). Dept. de Estudios Ambientales.
R. Montes, and J. J. San Jose.

Biogeochemistry BIOGEP, Vol. 7, No. 3, p 241-256, May 1989. 2 fig, 3 tab, 45 ref.

Descriptors: *Nutrients, *Savannas, *Venezuela, *Chemistry of precipitation, Phosphates, Ammonium, Nitrates, Sulfates, Calcium, Magnesium, Potassium, Sodium, Hydrogen ion concentration, Cycling nutrients, Orinoco Llanos, South America.

Samples of bulk precipitation were collected in the Trachypogon savanna, Calabozo, Venezuela, during three consecutive years. In the first year, rain samples were taken daily; in the following years the samples were grouped on a monthly basis. In addition, samples of dry deposition were collected during the dry seasons. All samples were analyzed for the following water soluble cations and anions: PO4-P, SO4-S, NO3-N, NH4-N, Ca(++), Mg(++), K(+), Na(+) and H(+). The mean annual input rate of chemical constituents kg/ha/yr was: PO4-P (0.42); SO4-S (2.62), NO3-N (0.21); NH4-N (2.03); Ca(++) (3.50); Mg(++) (11.31); K(+) (3.60); Na(+) (5.93); and H(+) (0.03). The total mean input of particulate material to the savanna during the dry season was 2.06 kg/ha/yr with a soluble fraction of 30 %. Possible sources of nutrients input were analyzed. (Author's abstract)
W90-00304

NITROGEN FLOWS IN LOUISIANA GULF COAST SALT MARSH: SPATIAL CONSIDERATIONS.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2L.
W90-00305

SEASONAL VARIATION OF METHANE EMISSIONS FROM A TEMPERATE SWAMP.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2H.
W90-00306

SEASONAL AND INTER-ANNUAL VARIATIONS OF NITROGEN DIAGENESIS IN THE SEDIMENTS OF A RECENTLY IMPOUNDED BASIN.
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
For primary bibliographic entry see Field 2H.
W90-00307

HYDROLYSIS OF CHLOROSTILBENE OXIDE: I. HYDROLYSIS IN HOMOGENEOUS SYSTEMS.
Georgia Univ., Athens.
For primary bibliographic entry see Field 5B.
W90-00309

ACID RAIN, CATION DISSOLUTION, AND SULPHATE RETENTION IN THREE TROPICAL SOILS.
University of Agricultural Sciences, Bangalore (India).
For primary bibliographic entry see Field 5C.
W90-00323

CLOUDWATER CHEMISTRY IN SEQUOIA NATIONAL PARK.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2B.
W90-00345

GROUNDWATER CHEMISTRY AND CATION BUDGETS OF TROPICAL KARST OUTCROPS, PENINSULAR MALAYSIA: I. CALCIUM AND MAGNESIUM.
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
J. Crowther.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 169-192, March 30 1989. 9 fig, 8 tab, 57 ref.

Descriptors: *Geochemistry, *Water chemistry, *Groundwater, *Karst, *Karst hydrology, *Calcium, *Surface-groundwater relations, *Magnesium, *Trace elements, Carbon dioxide, Water analysis, Chemical properties, Cations, Aeration zone.

The discharge and chemical properties of 217 autogenic groundwaters were monitored over a 1-yr period in the tower karsts of central Selangor and the Kinta Valley, and in the Setul Boundary Range. Because of differences in soil CO2 concentration, calcium concentrations are significantly higher in the Boundary Range (mean, 82.5 mg/l) than in the tower karst terrain (44.6 mg/l). Local differences in both source area CO2 concentration and amounts of secondary deposition underground cause marked intersite variability, particularly in the tower karst. Dilution occurs during flood peaks in certain conduit and cave stream waters. Generally, however, calcium correlates positively with discharge, since the amount of secondary deposition per unit volume of water decreases at higher flows. Magnesium concentrations and Mg:Ca + Mg ratios of groundwaters are strongly influenced by bedrock composition, though bedrock heterogeneity and the kinetics and equilibria of carbonate dissolution reactions preclude extremely low or high Mg:Ca + Mg values. Net chemical denudation rates range from 56.6 to 70.9 cu m sq km/yr. The results are considered in relation to cation fluxes in surface runoff, soil throughflow and nutrient cycling. Preliminary calcium and magnesium budgets show that (1) dissolutional activity is largely confined to the near-surface zone; and (2) the annual uptake of calcium and magnesium by tropical limestone forests is similar in magnitude to the net solute output in groundwaters. (Author's abstract)
W90-00362

ORGANIC OXIDATION AND MANGANESE AND ALUMINUM MOBILIZATION IN FOREST SOILS.
California Univ., Berkeley. Dept. of Plant and Soil Biology.
A. A. Pohlman, and J. G. McColl.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 686-690, May/June 1989. 4 fig, 3 tab, 23 ref.

Descriptors: *Model studies, *Manganese, *Forest soils, *Aluminum, *Oxidation-reduction potential, *Soil chemistry, Kinetics, Chemical properties, Acid rain effects.

A kinetic model describes the initial and rapid redox processes between polyhydroxyphenolic acid and soil or manganese oxide suspensions. The rate constants derived by the model were similar in magnitude in both suspensions for the organic reductants studied. Polyhydroxyphenolic acids with para and ortho-OH groups were rapidly oxidized by manganese oxides with spectral evidence suggesting that the reaction leads to polymeric humic products by way of benzoquinone derivatives. In contrast, polyhydroxyphenolic acids with meta-oriented phenolic-OH groups were not oxidized by soil or by manganese oxide suspensions within the 120-min reaction period, presumably because these compounds were not capable of being oxidized to benzoquinone intermediates. The oxidative process was also accompanied by formation of Mn(2+) both from soil and from manganese oxide suspensions. The rate of Mn(2+) formation by gallic acid from Challenge A horizon soil suspensions containing a total of 0.00036 mol/L Mn content was comparable to the rate from birnessite suspensions containing a total of 0.00025 mol/L Mn content. The appearance of Mn(2+) in soil suspensions within the reaction period was attributed mainly to reduction rather than clelation by the organic reductants or their products of oxidation. Dissolution of soil Mn also occurred by 2,5-dihydroxybenzoic, and 3,4-dihydroxybenzoic acids, but not by 2,6-dihydroxybenzoic and 3,5-dihydroxybenzoic acids. Humic products formed from oxidation by Mn were quite effective chelators of Al. The rates of Al dissolution by humic products from Blodgett A horizon soil in suspensions were comparable to the rates in the original organic acids, and were 3 to 6 times faster in dissolving Al than mineral acid at comparable pH levels. The parallel behavior in reactivities of both soil and manganese oxide suspensions toward polyhydroxyphenolic acids suggests that manganese oxides are being reduced in both systems. (Author's abstract)
W90-00380

GYPSUM OCCURRENCE IN SOILS ON THE MARGIN OF SEMIPERMANENT PRAIRIE POTHOLE WETLANDS.
Iowa State Univ., Ames. Dept. of Agronomy.
A. L. Steinwand, and J. L. Richardson.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 836-842, May/June 1989. 9 fig, 4 tab, 43 ref.

Descriptors: *North Dakota, *Wetlands, *Surface-groundwater relations, *Groundwater recharge, *Gypsum, *Soil chemistry, *Geomorphology, *Saline soils, Minerals, Geohydrology, Geochemistry, Salinity.

A series of three wetlands in a local recharge-throughflow-discharge groundwater flow system were investigated to determine factors controlling concentration of gypsum at the wetland edge. The three wetlands differ in pond size, permanence, salinity, and in their relationship to the groundwater hydrology. It is believed gypsum accumulation resulted from long term hydrologic, geomorphic, and climatic factors. Wetland salinity appeared to control the distribution and amount of gypsum in soils around individual wetlands and between wetlands. In all wetlands gypsum was concentrated at the edge; presumably as a result of dissolved salt transport to an area of low water potential created by evapotranspiration and freezing (edge effect). The water flow from the edge effect converged on the peninsulas and diverged in the bays. Consequently, in less saline wetland, the bay soils contained minimal amounts of gypsum; peninsula soils were very gypsiferous. Wetlands of high salinity were surrounded by a continuous band of evaporites including gypsum. Within individual wetlands, differences in the degree and number of ponding events and groundwater recharge-discharge resulted in variations in gypsum distribution across soils of the low prairie, wet meadow and shallow marsh vegetation zones. (Author's abstract)
W90-00383

CHEMICAL MODELLING APPLICATIONS TO EXPERIMENTAL RECIRCULATING STREAMS.
Freshwater Biological Association, Wareham (England). River Lab.
W. A. House, N. Shelly, and A. M. Fox.
Hydrobiologia HYDRB8, Vol. 178, No. 2, p 93-112, July 14, 1989. 11 fig, 2 tab, 25 ref.

Descriptors: *Streams, *Water chemistry, *Calcite, *Calcium carbonate, *Phosphorus, *Phosphates, *Carbon dioxide, *Oxygen transfer, Plants, Algae.

Chemical models describing the precipitation of calcium carbonate, coprecipitation of inorganic phosphate, carbon dioxide and oxygen transfer through the air-water interface have been applied to results from a recirculating experimental stream. The transfer velocities for carbon dioxide and oxygen transfer for the stream were 0.0001 m/s and 0.0058 m/min (at 20 C) respectively. During a 24-h long experiment the stream, containing a varied biota dominated by the macro-algae Zygnema, was monitored to evaluate changes in the water chemistry. The calcite precipitation rate varied during the experiment reflecting changes in temperature, supersaturation of the water and local variation in the solution chemistry at the growth sites. The rate constant was evaluated from a chemical mechanistic model as 516.7 27.2 mol/h at 10 C. The coprecipitation of inorganic phosphate, which accompanied calcite growth, accounted for <6% of the total phosphorus loss. The constant uptake of phosphorus by plants and algae was estimated as 0.22 micromol/h/g (dry weight). The rates of production of oxygen and consumption of inorganic carbon in the experimental stream, after taking account of gas transfer and calcite precipitation, were also computed and found to be in good agreement during the experiment. The maximum

rate of production of oxygen was 0.00035 mol/h/g (dry weight). (Author's abstract)
W90-00403

DETERMINATION OF TOTAL SULFUR IN FRESHWATER SEDIMENTS BY ION CHROMATOGRAPHY.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 5A.
W90-00418

NUTRIENT INPUT AND OUTPUT OF AN IRRIGATED AGROECOSYSTEM IN AN ARID MEDITERRANEAN LANDSCAPE.
Mediterranean Agronomic Inst. of Zaragoza (Spain).
For primary bibliographic entry see Field 3F.
W90-00432

APPLICATION OF THE QWASI (QUANTITATIVE WATER AIR SEDIMENT INTERACTION) FUGACITY MODEL TO THE DYNAMICS OF ORGANIC AND INROGANIC CHEMICALS IN LAKES.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5B.
W90-00435

INFLUENCE OF PH ON STRUVITE FORMATION BY BACTERIA.
Granada Univ. (Spain). Dept. of Microbiology.
I. Perez-Garcia, M. A. Rivadeneyra, and Ramos-Cormenzana.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1633-1638, 1989. 2 fig, 3 tab, 11 ref.

Descriptors: *Mineralization, *Diagenesis, *Aquatic bacteria, *Hydrogen ion concentration, *Bacteria, *Soil bacteria, *Struvite, Crystallization, Precipitation.

The pH influence on struvite precipitation, by 54 bacterial strains isolated from soil and water, is examined as part of a larger study aimed at determining optimal conditions for struvite formation by bacteria. Struvite precipitation was observed at all pHs studied. Although some strains formed struvite at pH 5, 5.5 and 6, the amount of crystals precipitated was lower than that precipitated at high pHs. At 6.5, a significant increase in the number of strains forming struvite can be observed and also in the amount of crystals improve type. The best results were obtained at between pH 7 and 8. In this interval, results with regard to the number of forming strains were obtained. At pH 7.5, in some strains, an increase in the amount of crystals precipitates is observed. At pH 8.5 and 9, both the number of strains forming struvite and the amount of crystal precipitation decreases. It can be deduced that in the case of bacterial precipitation of struvite, there is an increase in pH depending on the initial pH and the strain studies. Usually, cultures with low initial pH tend to increase their pH while those with high initial pH tend to decrease their pH. These changes are not always the same, since they depend on the struvite-forming strain in question. (Miller-PTT)
W90-00443

WATER SOLUBILITY ENHANCEMENTS OF DDT AND TRICHLOROBENZENE BY SOME SURFACTANTS BELOW AND ABOVE THE CRITICAL MICELLE CONCENTRATION.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-00536

'RED HERRING' LAKES AND STREAMS IN THE ACID-RAIN LITERATURE.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W90-00556

ACTINIDE BEHAVIOR IN NATURAL WATERS.
Florida State Univ., Tallahassee. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-00558

WEATHERING RATES AND SR87/SR86 RATIOS: AN ISOTOPIC APPROACH.
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
G. Aberg, G. Jacks, and P. J. Hamilton.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 65-78, July 1989. 4 fig, 6 tab, 22 ref. Swedish Environmental Protection Board grant 101/83.

Descriptors: *Strontium, *Sweden, *Weathering, *Acid rain, Precipitation, Throughfall, Groundwater, Streamflow, Calcium, Sulfur, Isotope studies, Runoff.

The Sr87/Sr86 ratios of precipitation, throughfall, groundwater, streamwater and mineral matter were analyzed for the Baskbacken catchment in the Malingsbo-Kloten area, south-central Sweden. Precipitation strontium ratios were around 0.71; throughfall, which is affected by strontium from the mineral soil, had ratios of 0.72-0.73; and shallow groundwater in a dug well and runoff had ratios around 0.73-0.74. There was a tendency for this relationship to be reversed for discharge, with higher ratios associated with lower discharges. Water from a fracture zone gave the highest value (0.78), approaching the value of the bedrock (around 0.85). The calcium budget, which reflects the mean condition over a few years, indicated that weathering should be of the order of 8 kg Ca/ha/yr to maintain the pool of exchangeable calcium at a constant level. The major ion in the runoff is sulfate, which enters the system in the form of 'acid rain'. Sulfur deposition has been rather constant over the last two decades. If acidification had an effect on weathering of silicates this would have shown up in a tendency of the strontium isotope ratios toward higher values in the soil pool and in runoff water. Thus it seemed from the observed ratios that at least a major portion of the excess calcium export resulting from sulfur deposition is taken from the soil pool, resulting in a gradual acidification of the soil. (Author's abstract)
W90-00578

INFLUENCE OF THE OVERSTORY, UNDERSTORY AND UPPER SOIL HORIZONS ON THE FLUXES OF SOME IONS IN A MIXED DECIDUOUS FOREST.
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2I.
W90-00585

HYDROGEOCHEMISTRY IN THE BARBADOS ACCRETIONARY COMPLEX: LEG 110 ODP.
Scripps Institution of Oceanography, La Jolla, CA.
J. Gieskes, G. Blanc, P. Vrolijk, J. C. Moore, and A. Mascle.
Palaeo PPPYAB, Vol. 71, No. 1/2, p 83-96, June 15, 1989. 9 fig, 38 ref.

Descriptors: *Geochemistry, *Interstitial water, *Drill holes, *Geohydrology, *Geologic fractures, Accretion, Sedimentary structures, Sedimentary rocks, Advection, Fluid flow, Calcium, Magnesium, Sodium, Chlorides, Methane, Thermal water, Structural models, Drilling, Ocean bottom.

Detailed studies of the chemical composition of interstitial waters in the sediments obtained along a drill hole transect across the accretionary prism of the Northern Barbados Ridge have revealed a complex set of processes: (1) in Plio-Pleistocene volcanic ash-bearing sediments increased concentrations of dissolved calcium and decreases in dissolved magnesium are the result of volcanic ash alteration; (2) below the decollement large concentration increases in dissolved calcium, accompanied by large decreases in sodium as well as a gradual decrease in dissolved magnesium, suggest exchange of these constituents with the deeper seated rocks of layer 2 of the oceanic crust; (3) low chloride concentrations, particularly associated with the decollement zone separating the converging plates and underthrusted sandstones, and also with recent faults in the accretionary complex, suggest advective transport of low chlorinity waters from deeper within the accretionary complex. In and below the decollement zone elevated concentrations of methane of thermogenic origin have been measured. The drilling of the transect across the Barbados Accretionary Complex provides a structural model that may apply to the mode of transport of methane-rich fluids that have been observed to vent at the sea floor in other accretionary complexes off the coast of Oregon and off Japan. (Author's abstract)
W90-00637

ROLE OF ORGANIC ACIDS IN THE ACIDIFICATION OF SURFACE WATERS IN THE EASTERN U.S.
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, R. D. Fuller, and W. D. Schecher.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 21-40, January 1989. 10 fig, 1 tab, 29 ref.

Descriptors: *Acid rain, *Acidic water, *Inorganic acids, *Surface water, *Organic compounds, *Lake basins, Dissolved solids, Anions, Neutralization, Glacial soils, Model studies, Maine, Florida, Midwestern United States.

There is considerable uncertainty concerning the role of naturally occurring organic solutes in the acidification of surface waters. To provide a preliminary assessment of this process water chemistry data obtained from the U.S. E.P.A. Eastern Lake Survey (ELS) was evaluated. A wide range of dissolved organic carbon (DOC) and organic anion concentrations were evident across acid-sensitive lake districts in the eastern U.S.. In particular, lakes in Maine, the upper Midwest and Florida contained high concentrations of DOC, and of organic anions suggesting that dissociation of naturally occurring organic acids could significantly reduce the acid neutralizing capacity of dilute surface waters. As a first step to assess the acid/base characteristics of naturally occurring organic solutes, an Oliver model was calibrated using a reduced version of the ELS data set. This model explained 94% of the observed variability in organic anion concentration in this data set. Finally, data from the ELS indicates that across glaciated regions of the eastern U.S., concentrations of DOC and organic ions were negatively correlated with SO4(-). This trend would appear to be consistent with the hypothesis that inputs of strong acids immobilize organic acids, resulting in a shift of surface water acidification by organic acids to strong acids. (Author's abstract)
W90-00641

EFFECTS OF ACIDIC PRECIPITATION, O3, AND SOIL MG STATUS ON THROUGHFALL, SOIL, AND SEEDLING LOBLOLLY PINE NUTRIENT CONCENTRATIONS.
Tennessee Valley Authority, Oak Ridge.
For primary bibliographic entry see Field 5C.
W90-00648

DETERMINATION OF THE ISOTOPIC COMPOSITION OF AMMONIUM-NITROGEN AT THE NATURAL ABUNDANCE LEVEL FROM ESTUARINE WATERS.
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W90-00693

IMPORTANCE OF SEDIMENTS IN UNDERSTANDING NUTRIENT CYCLINGS IN LAKES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W90-00717

CHARACTERISTICS OF SETTLING MATTER AND ITS ROLE IN NUTRIENT CYCLES IN A DEEP OLIGOTROPHIC LAKE.
National Inst. for Environmental Studies, Ibaraki (Japan).

For primary bibliographic entry see Field 2H.
W90-00718

COUPLING OF STRONTIUM AND CALCIUM CYCLES IN LAKE CONSTANCE.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
For primary bibliographic entry see Field 2H.
W90-00721

MICROORGANISMS AND THE AQUATIC ENVIRONMENT.
Melbourne Univ., Parkville (Australia). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W90-00724

ADSORPTION-DESORPTION OF PHOSPHORUS BY LAKE SEDIMENTS UNDER ANAEROBIC CONDITIONS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
For primary bibliographic entry see Field 2H.
W90-00822

PHOSPHORUS EXCHANGE KINETICS AND EXCHANGEABLE PHOSPHORUS FORMS IN SEDIMENTS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
For primary bibliographic entry see Field 5B.
W90-00823

COMPARATIVE STUDY OF WATER MINERALIZATION AND NUTRIENT STATUS IN THE MAIN WATER COURSES OF BISCAY (BASQUE COUNTRY).
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
For primary bibliographic entry see Field 5B.
W90-00826

FRACTIONATION OF PARTICULATE MATTER, THE TRACE METALS CU, CD, AND ZN, AND LIPIDS IN FOAM AND WATER BELOW NIAGARA FALLS.
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
B. D. Johnson, X. Zhou, C. C. Parrish, P. J. Wangersky, and B. R. Kerman.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 189-196, 1898. 0 fig, 2 tab, 21 ref.

Descriptors: *Water chemistry, *Path of pollutants, *Carbon, *Heavy metals, *Copper, *Zinc, *Cadmium, *Lipids, *Niagara Falls, Foam, Fatty acids, Polarity.

Concentrations of dissolved and particulate carbon, the trace metals Cu, Cd, and Zn, and classes of lipids were measured in sub-surface water (30 cm depth) and foam below Niagara Falls. All substances measured were highly enriched in the foam fraction. Relative to sub-surface concentrations, foam samples of particulate organic carbon were enriched by 6,700, the particulate trace metals Cu by over 1,300, Cd by more than 250, and Zn by nearly 200. Lipid classes were enriched in foam by a factor of 25 or less for lipids of polarity less than that of free fatty acids, and by over 50 for lipids of greater polarity. (Author's abstract)
W90-00838

LIQUID CHROMATOGRAPHY SYSTEM FOR MEASUREMENT OF ORGANIC ACIDS IN PRECIPITATION.
Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-00857

SOIL EFFECTS ON WATER CHEMISTRY IN THREE ADJACENT UPLAND STREAMS AT GLENDYE IN NORTHEAST SCOTLAND.
Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-00912

CALCIUM BUDGETS FOR CATCHMENTS AS INTERPRETED BY STRONTIUM ISOTOPES.
Royal Inst. of Tech., Stockholm (Sweden).
G. Jacks, G. Aberg, and P. J. Hamilton.
Nordic Hydrology NOHYBB, Vol. 20, No. 2, p 85-96, 1989. 3 fig, 7 tab, 15 ref.

Descriptors: *Acid rain effects, *Sulfates, *Calcium, *Weathering, *Neutralization, *Strontium radioisotopes, Calcium sulfate, Acidity, Sweden, Dry deposition.

Strontium isotopes in precipitation, soil and runoff water can be used to establish a ratio of wet plus dry deposited Sr to Sr released by weathering. This ratio is especially enhanced in areas with old acid Proterozoic rocks (0.6-2.5 Ga) and Archean rocks (>2.5 Ga). Since Sr and Ca behave in an analogous way in the coniferous forest ecosystem the results for Sr can be used for the determination of Ca. If the deposition of calcium can be calculated reasonably accurately the weathering rate can also be estimated. Five catchments in Sweden have been investigated using this approach. Three of them seem to be close to a steady state, wherein the losses and gains of calcium to the system are equal. In the two southern-most catchments there seems to be an ongoing loss of exchangeable calcium. The loss by runoff occurs with sulfate being the dominant anion. Weathering rates of 1.5 to 4.8 kg Ca/ha year have been estimated. (Author's abstract)
W90-00918

LAPLACE TRANSFORM GALERKIN TECHNIQUE: A TIME-CONTINUOUS FINITE ELEMENT THEORY AND APPLICATION TO MASS TRANSPORT IN GROUNDWATER.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2F.
W90-00949

ION ELUTION THROUGH SHALLOW HOMOGENEOUS SNOW.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W90-00952

CHARACTERIZATION AND ISOTOPIC COMPOSITION OF ORGANIC AND INORGANIC CARBON IN THE MILK RIVER AQUIFER.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W90-00954

LEACHING OF N AND C FROM BIRCH LEAF LITTER AND RAW HUMUS WITH SPECIAL EMPHASIS ON THE INFLUENCE OF SOIL FAUNA.
Jyvaeskylae Univ. (Finland). Dept. of Biology.
V. Huhta, H. Setala, and J. Haimi.
Soil Biology & Biochemistry SBIOAH, Vol. 20, No. 6, p 875-878, 1988. 2 fig, 1 tab, 21 ref.

Descriptors: *Soil chemistry, *Leaching, *Biodegradation, Nitrogen, Carbon, Soil organisms.

To examine the role of a community of soil animals in N-mineralization and C fluxes in dead organic matter, a microcosm system was established with substrates composed of (1) birch leaf litter; (2) raw coniferous humus; and (3) litter on humus. Every 3-4 wks the substrates were irrigated with distilled water, and the amounts of NO3-N, NH4-N, total-N and total-C (as well as humic substances at one recording) in the leachates were analyzed. At the end of the experiment, water soluble and exchangeable forms of N were measured in the test materials. The differences in the release of N were clear both between the replicates with and without soil animals and between the different forms of N. From wk 10 onwards the fauna enhanced significantly the leaching of total-N and NH4-n from the humus alone. The release of total-N from the litter alone was also increased by the fauna. The presence of animals did not significantly affect any form of KCl-extractable N. The amounts of total C in the leachates increased significantly in almost all samples when the fauna was involved. In addition, the fauna affected the humification process positively in the litter + humus and in humus alone, i.e. relatively more humic substances than total C were liberated from the materials in the presence of animals. (Author's abstract)
W90-00961

2L. Estuaries

CONTAMINATION, BIOACCUMULATION, AND ECOLOGICAL EFFECTS OF CREOSOTE-DERIVED COMPOUNDS IN THE NEARSHORE ESTUARINE ENVIRONMENT OF PENSACOLA BAY, FLORIDA.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00027

DEVELOPING A MATHEMATICAL MODEL SYSTEM FOR THE RHINE: MEUSE ESTUARY.
Waterloopkundig Lab. te Delft (Netherlands).
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-108963. Price codes: E03 in paper copy, A01 in microfiche. Report No. PUB-384, November 1987. 20p, 6 fig, 6 ref.

Descriptors: *Model studies, *Estuaries, *Hydraulic models, *Rhine River, *Meuse River, Mathematical models, Computer programs, Saline-freshwater interfaces, Tidal hydraulics, Channel morphology, Water quality.

At Delft Hydraulics a mathematical model system for the Rhine-Meuse estuary is developed for the Ministry of Transport and Public Works, the Netherlands. The aim of this development is to provide this Ministry, with tools to study problems in the field of tidal salt/fresh flows, morphology and water quality. The mathematical models will have to replace the existing hydraulic scale model of the Rhine-Meuse estuary, in which systematic studies were and still are performed on the density induced tidal flows and mixing processes for a wide range of physical and geometrical conditions. The paper describes difficulties and uncertainties in developing such a mathematical model system with respect to hardware and software and the rapid evolutions in the scope of estuarine management issues, emphasizing more and more the importance of morphological and water quality problems. (Lantz-PTT)
W90-00136

EXPECTATIONS FOR WATER LEVEL DEVIATIONS AT THE DELTA WORKS: ZLERIKZEE (NETHERLANDS), NOVEMBER 1981-FEBRUARY 1986 (VERWACHTINGEN VOOR WATER-STANDSAFWIJKINGEN DELTAWERKEN: ZIERIKZEE NOVEMBER 1981-FEBRUARI 1986).
A. W. Donker.
Available from National Technical Information Service, Springfield, VA 22161 as N88-13840/9/GAR. Price codes: A03 in paper copy, A01 in microfiche. 1987. 25p, 10 fig, 3 tab, 49 ref. English summary.

Descriptors: *The Netherlands, *Deltas, *Water level, *Water level recorders, Water level fluctuations, Tides, Forecasting.

The water level forecasting for the East Scheldt (Netherlands) mouth during the conduct of delta works is discussed. The forecasting term was 24 hr, with further prospects for 36 hr. For water level deviation forecasting the weather service paid special attention to the announcement of quiet water, combinations of low level increases during high tide and low decreases during low tide, decreases of 50 cm or more during low tide, and substantial

water level increases. The instruments used by the weather service are presented. The program for the verification of the 24 hr forecasts is explained. The usefulness of the results is demonstrated. (Author's abstract)
W90-00185

SEDIMENT/WATER-COLUMN FLUX OF NUTRIENTS AND OXYGEN IN THE TIDAL PATUXENT RIVER AND ESTUARY, MARYLAND.
B. M. Lantrip, R. M. Summers, D. J. Phelan, and W. Andrle.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2296, 1987. 76p, 25 fig, 7 tab, 20 ref.

Descriptors: *Sediment-water interfaces, *Cycling nutrients, *Oxygen, *Estuaries, *Patuxent River, *Maryland, Water quality, Fluctuations, Nitrites, Nitrates, Water temperature, Macroorganisms, Seasonal variation, Ammonium.

An intensive study was made of the flux of nutrients and oxygen between the water column and the sediments of the tidal Patuxent River and Estuary. Eleven stations were monitored on a quarterly basis over a 2-year period. Flux rates were calculated based on the change in concentration of various nutrient species within in situ benthic respirometers. The estuarine anoxic sediment was a consistently higher source of ammonium, while the tidal river showed greater flux of nitrite plus nitrate in both directions. Dissolved reactive phosphorus flux was into the sediment in the tidal river and transition zones and from the sediment in the estuary. Sediment oxygen demands were variable, but median values were generally consistent among the different zones. A major feature of the data is the large spatial and temporal variability in sediment nutrient flux and oxygen demand reflecting influence but lack of dominance of many interacting factors, including sediment nutrient concentrations, sediment grain size, water temperature, oxygen availability, benthic macroorganism populations, and meteorological conditions. Part of this variation is due to spatial or seasonal differences in controlling factors, but year-to-year differences at individual stations during a given season are also large. (Lantz-PTT)
W90-00209

WELL SYSTEM TO RECOVER USABLE WATER FROM A FRESHWATER-SALTWATER AQUIFER IN PUERTO RICO.
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 4B.
W90-00225

HEAVY METAL CONCENTRATIONS IN THE MEDITERRANEAN ESTUARINE REGIONS OF THE RHONE, EBRO, PO, AND ARNO RIVERS (ERMITTLUNG DER AKTUELLEN SCHWERMETALLBELASTUNGEN IN DEN MITTELMEERASESTUARIEN VON RHONE, EBRO, PO UND ARNO).
Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet.
For primary bibliographic entry see Field 5B.
W90-00273

RESPIRATION AND OSMOREGULATION OF THE ESTUARINE CRAB, RHITHROPANOPEUS HARRISII (GOULD): EFFECTS OF THE HERBICIDE, ALACHLOR.
Duke Univ., Beaufort, NC. Marine Lab.
For primary bibliographic entry see Field 5C.
W90-00278

ABUNDANCE OF LARVAL RAINBOW SMELT (OSMERUS MORDAX) IN RELATION TO THE MAXIMUM TURBIDITY ZONE AND ASSOCIATED MACROPLANKTONIC FAUNA OF THE MIDDLE ST. LAWRENCE ESTUARY.
Laval Univ., Quebec. Dept. de Biologie.
J. J. Dodson, J. Dauvin, R. G. Ingram, and B. D'Anglejan.
Estuaries ESTUDO, Vol. 12, No. 2, p 66-81, June 1989. 10 fig, 7 tab, 32 ref.

Descriptors: *Population density, *Larval growth stage, *Smelt, *Estuaries, *St Lawrence Estuary, *Turbidity, *Zooplankton, Density stratification.

The hypothesis that the distribution and retention of larval smelt (Osmerus mordax) in the middle estuary of the St. Lawrence River is related to the maintenance of other planktonic organisms in the maximum turbidity zone (MTZ) was studied. The horizontal and vertical distribution of larval smelt, macrozooplankton, and suspended particulate matter over four tidal cycles at each of three stations located along the major axis of the turbid upstream portion of the middle estuary was documented. During summer, the turbid waters of the two upstream stations were characterized by Neomysis americana, Gammarus sp. (principally G. tigrinus), larval smelt, Mysis stenolepis, and Crangon septemspinosus. The more stratified and less turbid waters of the downstream station were characterized by a costal marine macrozooplanktonic community and almost total absence of smelt larvae. Smelt larvae were distributed further upstream within the MTZ than N. americana. The relationship between turbidity and larval density at a specific time was weak, but the mechanism responsible for producing higher residence times for both sediment and larvae on a longer term basis appears the same. The daily movement and skewed nature of the zone of longest average advective replacement times due to the general cyclonic circulation of the middle estuary defines a geographic zone over which the larval smelt population oscillates and remains despite the mean downstream velocities over the water column. (Author's Abstract)
W90-00279

POTENTIAL ROLE OF ROOTS AND RHIZOMES IN STRUCTURING SALT-MARSH BENTHIC COMMUNITIES.
North Carolina Univ., Wilmington. Dept. of Biology.
A. A. Capehart, and C. T. Hackney.
Estuaries ESTUDO, Vol. 12, No. 2, p 119-122, June 1989. 1 fig, 1 tab, 25 ref.

Descriptors: *Rhizosphere, *Salt marshes, *Ecosystems, *Ecological distribution, *Benthic environment, *Plant populations, *Marshes, *Clams, *Benthos, *Roots, Rhizomes, Sediments, Tidal marshes, Density, Biomass.

The density of the Carolina marsh calm, Polymesoda caroliniana (Bosc), was determined in three adjacent tidal marsh communities which differed only in plant species composition. Clam density was inversely related to the density (biomass) of plant roots and rhizomes in sediments and directly related to density of plant stems (numbers). Clam abundance was not related to the basal area of plant stems. Each plant community contained clams of various ages from juvenile to adult indicating continued recruitment and survival. These data suggest that P. caroliniana is most abundant in Juncus roemerianus marshes because there are fewer roots and rhizomes (mean of 2.5 kg/sq m) to hamper burrowing as compared to Spartina alterniflora and S. cynosuroides (5.1 and 6.3 kg/sq m, respectively) dominated marshes. Salinity, flooding frequency, distance from flooding water, and sediment type were essentially constant among the three plant communities. Root/rhizome density should be collected along with other environmental parameters during studies of benthic organisms on marshes because it potentially limits the occurrence or abundance of some species. (Author's Abstract)
W90-00280

DISTRIBUTION AND ACTIVITY OF PICOPHYTOPLANKTON IN A BRACKISH ENVIRONMENT.
Messina Univ. (Italy). Dept. di Biologia Animale ed Ecologia Marina.
For primary bibliographic entry see Field 2H.
W90-00284

DIEL AND SPATIAL VARIATIONS IN BACTERIAL DENSITY IN A STRATIFIED WATER COLUMN OF THE GULF OF TRIESTE.
Vienna Univ. (Austria). Zoologisches Inst.
G. J. Herndl.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 139-146, 1988. 2 fig, 25 ref. FWF-Project Nr. 6138 and 6695.

Descriptors: *Marine bacteria, *Stratification, *Coastal waters, *Bacteria, Phytoplankton, Population density, Gulf of Trieste, Spatial distribution, Diurnal distribution, Primary productivity, Cycling nutrients, Carbohydrates, Sedimentation.

The diel variations in bacterial density and activity at various depths of the stratified water column of the Gulf of Trieste and the influence of the accumulated aggregations of microbes (also known as marine snow) on microbial activities within the pycnocline layer were investigated. Distinct diel variations in microbial parameters were detected. In most of the measurements the early morning dissolved organic carbon (DOC) content peak exceeded the afternoon DOC maximum. Pronounced diel differences in bacterial activity were largely restricted to the upper layers of the water column while in the vicinity of the pycnocline no such diel cycles in bacterial activity were detectable. An average marine snow mass of 9.8 grams/cu m was obtained in the pycnocline layer which is approximately twice the amount of the marine snow load of the water column above the pycnocline. Sedimenting marine snow transported about 40% more carbohydrate than required for bacterial growth, so the efficient utilization of marine snow as a carbon and nitrogen source is plausible. The data demonstrate a tight coupling between phytoplankton production and bacterial activity in the mixed water layer above the pycnocline. The occurrence of marine snow particles and the associated biota embedded in the CHO-rich matrix may be viewed as self sufficient trophic loops in regenerating systems, as marine snow appears in the water column during decay of phytoplankton. Thus bacterial activity in the pycnocline is not as directly related to phytoplankton extracellular release during photosynthesis as it has been demonstrated for waters above the pycnocline. (Gadsby-PTT)
W90-00285

EFFECT OF POLLUTION ON THE BACTERIAL COMMUNITY STRUCTURE IN THE COASTAL WATERS OF THE EASTERN MEDITERRANEAN SEA.
Israel Oceanographic and Limnological Research Ltd., Haifa.
For primary bibliographic entry see Field 5C.
W90-00286

HETEROTROPHIC PROCESSES IN EUTROPHICATED AQUATIC MARINE ENVIRONMENTS.
Centre Univ. de Luminy, Marseille (France).
For primary bibliographic entry see Field 5C.
W90-00287

MINERALIZATION OF ORGANIC MATERIAL IN COASTAL EUTROPHIC ECOSYSTEMS ACCORDING TO AVAILABLE TERMINAL ELECTRON ACCEPTORS.
Centre Univ. de Luminy, Marseille (France).
D. Marty, J. C. Bertrand, P. Caumette, and A. Bianchi.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 167-176, 1988. 4 fig, 1 tab, 26 ref.

Descriptors: *Cycling nutrients, *Mineralization, *Eutrophication, *Coastal waters, *Electron acceptors, *Organic matter, *Anaerobic bacteria, *Nitrates, *Sulfates, *Methane, *Cycling nutrients, Lagoon, Etang de Berre, Ecosystems, Temperature effects, Biodegradation, Sediments.

This study examines the competitive interactions between different anaerobic communities (nitrate reducing bacteria, sulfate reducing bacteria, and methanogenic bacteria) in an attempt to elucidate their relative contribution to carbon mineralization

and nutrient cycling in a temperate eutrophic lagoon, the Etang de Berre. The data demonstrate that the three bacterial activities determined can occur at the same depth in sediment profiles when organic matter is not a limiting factor. In surface sediments, the rate of nitrate reduction, sulfate reduction and methane production vary with respect to temperature, with increased rates correlated with increased sediment temperature. Thus sediment temperature seems to be the most important environmental variable influencing anaerobic processes in the lagoon sediment. In natural anaerobic ecosystems, these three bacterial groups play a vital role in anaerobic decomposition processes. Despite their similar role in anaerobic mineralization of organic matter, only the sulfate reducing bacteria dominate the particular environment. According to the thermodynamic efficiency of the different metabolic pathways investigated, the coexistence of nitrate and sulfate reduction and methane production in the same sedimentary level, can be accounted for the presence of microniches within the sediment. (Gadsby-PTT)
W90-00288

SEDIMENTARY FLUX OF NUTRIENTS AT A DELAWARE SALT MARSH SITE: A GEOCHEMICAL PERSPECTIVE.
Delaware Univ., Lewes. Coll. of Marine Studies.
J. R. Scudlark, and T. M. Church.
Biogeochemistry BIOGEP, Vol. 7, No. 1, p 55-75, January 1989. 8 fig, 3 tab, 64 ref. NOAA National Sea Grant No. NA80AA-D-00106.

Descriptors: *Diagenesis, *Delaware, *Delaware Bay, *Salt marshes, *Phosphates, *Sedimentation rates, *Cycling nutrients, *Geochemistry, Estuaries, Nitrates, Ammonium, Silicates.

A basic geochemical approach has been used to study the diagenetic cycling and sediment-water exchange rates of essential nutrients at a site in a Delaware salt marsh. The pore water nutrients Si(OH)4, NH4(+), PO4(---), and NO3(-) were analyzed and compared seasonally, and potential diffusive fluxes were calculated from the corresponding pore water concentration gradients. Concurrent direct flux measurements were also made using closed chambers deployed on the salt marsh surface under ambient and controlled conditions. The differences in these two approaches allows for estimation of nutrient production and consumption in the root zone and at the salt marsh surface. Silicate and phosphate appear to be primarily geochemically controlled, while the nitrogen species undergo dynamic seasonal redox fluctuations resulting from microbial mediation (e.g., nitrification and denitrification). Specifically: (1) silicate behaves rather conservatively according to silica solubility, (2) phosphate flux is controlled by the corresponding sequestering or reductive remobilization of surface iron oxides, and (3) ammonium has a strong upward flux, which appears to undergo quantitative nitrification in spring. None of the measured flux rates would have a major impact on the nutrient budget for the local estuary, Delaware Bay. (Author's abstract)
W90-00301

METHANOGENESIS AND MICROBIAL LIPID SYNTHESIS IN ANOXIC SALT MARSH SEDIMENTS.
Georgia Univ., Athens. Dept. of Microbiology.
H. R. Harvey, R. D. Fallon, and J. S. Patton.
Biogeochemistry BIOGEP, Vol. 7, No. 2, p 111-129, March 1989. 4 fig, 3 tab, 40 ref. NSF Grants PCM 821183 and OCE 8214899 and NIH Grant AM 2730405.

Descriptors: *Biosynthesis, *Anaerobic conditions, *Sediments, *Methane, *Interstitial water, *Microorganisms, *Lipids, Anoxic sediments, Georgia, Sapelo Island, Salt marshes.

In anoxic salt marsh sediments of Sapelo Island, GA, the vertical distribution of CH4 production was measured in the upper 20 cm of surface sediments in ten locations. In one section of high marsh sediments, the concentration and oxidation of acetate in sediment porewaters and the rate and amount of 14C acetate and 14CO2 incorporation into cellular lipids of the microbial population were investigated. CH4 production rates ranged from less than 1 to 493 nM CH4 gram per sediment x day from intact subcores incubated under nitrogen. Replacement with H2 stimulated the rate of methane release up to nine fold, relative to N2 incubations. Rates of lipid synthesis from CO2 averaged .392 nanomoles lipid carbon cm cubed per sediment x hour, suggesting that CO2 may be an important carbon precursor for microbial membrane synthesis in marsh sediments under anoxic conditions. Qualitative measurements of lipid synthesis rates from acetate were found to average .087 nanomoles. Phospholipids were the dominant lipids synthesized by both substrates in sediment cores, accounting for an average of 76.6% of all lipid radioactivity. Small amounts of ether lipids indicative of methanogenic bacteria were observed in cores incubated for seven days, with similar rates of synthesis for both CO2 and acetate. The low rate of ether lipid synthesis suggests that either methanogen lipid biosynthesis is very slow or that methanogens represent a small component of total microbial lipid synthesis in anoxic sediments. (Author's abstract)
W90-00302

NITROGEN FLOWS IN LOUISIANA GULF COAST SALT MARSH: SPATIAL CONSIDERATIONS.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. D. DeLaune, T. C. Feijtel, and W. H. Patrick.
Biogeochemistry BIOGEP, Vol. 8, No. 1, p 25-37, January 1989. 2 fig, 4 tab, 33 ref. NSF Grant no. BSR-8414006.

Descriptors: *Gulf of Mexico, *Cycling nutrients, *Salt marshes, *Estuaries, *Louisiana, *Nitrogen, Spartina, Barataria Basin, Nitrogen cycle, Spatial distribution.

Nitrogen flux data was synthesized in developing a nitrogen flow budget for a Louisiana Barataria Basin Spartina alterniflora salt marsh. Results demonstrate the importance of spatial consideration in developing a nitrogen budget for coastal marshes. Using a mass balance approach nitrogen inputs balanced nitrogen sinks or losses from a marsh soil-plant system with a specific rooting depth. However, per unit areas on a local scale, marshes served as a large sink for nitrogen due to rapid accretion which removes 17.0 g N/sq m/yr through subsidence below the root zone. On a larger spatial scale (regional) it was shown that the marshes did not serve as a large nitrogen sink. The rapid marsh deterioration currently occurring in the rapidly subsiding marshes of the Mississippi River deltaic plain accounted for a net regional loss of 12.5 g N/sq m/yr. Thus, regionally the net sink was equivalent to only 5 g N/sq m/yr as compared to 17.0 g N/sq m/yr on a local scale. (Author's abstract)
W90-00305

SUBTIDAL SALINITY AND VELOCITY VARIATIONS IN THE ST. LAWRENCE ESTUARY.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
K. T. Tee.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 94, No. 6, p 8075-8090, June 15, 1989. 17 fig, 2 tab, 28 ref.

Descriptors: *St Lawrence Estuary, *Estuaries, *Salinity, *Water currents, *Tidal currents, Density currents, Atmospheric pressure, Fluctuations.

Between April and September 1982, 14 current meters were moored at six stations along the St. Lawrence Estuary: two stations each in the lower, middle, and upper estuaries. The experimental data revealed a complex structure in the subtidal salinity and velocity variations, caused by a combination of tidal, atmospheric and density forcing. The results provided an important data base for modeling baroclinic variations in coastal estuaries. The salinity data indicated that the atmospheric forcing induced an 11.5-day oscillation which propagated as an internal Kelvin wave. However, the velocity data provided a different picture of wave propagation. The atmospheric forcing also induced salinity variations with a time scale of 40 to 50 days. The oscillation occurred initially in the middle estuary and then propagated toward upstream and downstream regions. Tidally rectified salinity and velocity oscillations at monthly and fortnightly periods were observed at two stations. From the results of an optimum multiple regression model, it was found that the tidally rectified component dominated the other components in the analyzed currents at these two stations. The freshwater pulse, characterized by a salinity minimum, has two time scales of variation: a long time scale of 73 days and a short time scale of 10-15 days. The long-period pulse was induced by the seasonal runoff. The short-period pulse was induced by two forcing mechanisms: vertical mixing by unusually strong tidal currents, and the advection of low-salinity water by wind-induced currents. The seasonal runoff also induced strong oscillations in the along-channel current in the lower estuary. This forcing of the current oscillation did not agree with a previously suggested forcing by atmospheric pressure. (Author's abstract)
W90-00321

TIDALLY GENERATED RESIDUAL CURRENTS IN A SEA LEVEL CANAL OR TIDAL STRAIT WITH CONSTANT BREADTH AND DEPTH.
Delaware Univ., Newark. Coll. of Marine Studies.
K. C. Wong.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 94, No. 6, p 8179-8192, June 15, 1989. 6 fig, 20 ref. NSF Grant OCE-8515735.

Descriptors: *Tidal hydraulics, *Straits, *Water currents, *Canals, *Tidal currents, Estuaries.

This study extends the analysis of Ianniello in deriving the two-dimensional (x-z) analytical solutions for the tidally induced residual currents in narrow sea level canals connecting two large adjoining bodies of water. The sea level canal is forced by tides from both open ends, and residual Eulerian and Lagrangian currents are induced in the canal by nonlinear interactions of the first-order tides. It was found that the residual currents were strongly influenced by the tidal amplitude and phase differences between the two open boundaries. Depending on the type of boundary tidal forcing, the residual Eulerian velocity flowed in either direction and produced two-layer structures in the vertical. The Stokes velocity worked either in concert or in opposition with Eulerian velocity, so the residual Lagrangian velocity may be greater than Eulerian. Given a particular set of boundary forcing conditions, the depth-averaged residual Lagrangian velocity was a nonzero constant, so residual mass transport between the adjoining water bodies through the canal was permitted. The most effective way of producing vigorous residual currents through the canal was for the tidal forcing at one open boundary to have a higher amplitude and a phase lead relative to the tidal forcing from the opposite end. (Author's abstract)
W90-00322

SALT INTRUSION MODEL FOR HIGH-WATER SLACK, LOW-WATER SLACK, AND MEAN TIDE ON SPREAD SHEET.
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 7C.
W90-00351

PROCESSES AND RATES OF PEDOGENESIS IN SOME MARYLAND TIDAL MARSH SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W90-00385

ANNUAL CYCLES AND BUDGET OF NUTRIENTS IN BERRE LAGOON (MEDITERRANEAN SEA, FRANCE).
Centre d'Oceanologie de Marseille (France).
R. Arfi.
Internationale Revue der Gesamten Hydrobiologie

IGHYAZ, Vol. 7, No. 1, p 29-49, 1989. 7 fig, 6 tab, 20 ref.

Descriptors: *Mediterranean Sea, *Lagoons, *Estuaries, *Nutrients, *Phytoplankton, Algae, Biomass, Seasonal variation, Berre Lagoon, France.

The annual cycles of nutrients in the Etang de Berre were studied in 1985. From measurements twice a month at the input points, daily data for the freshwater flow and from daily measurements at the output point, an estimation is proposed for a nutrient budget. Seasonal variability is important, and a biological control of nutrient availability (locally remineralized products) results in a hydrologically controlled system (nutrients carried by continental waters) which produces the very high microalgal biomass observed in the lagoon. The seasonal halocline brings the euphotic layer very close to the remineralization site: nutrients are then constantly available to the phytoplankton. (Author's abstract)
W90-00405

VARIATION OF PHYTOPLANKTON IN A TROPICAL ESTUARY (VELLAR ESTUARY, BAY OF BENGAL, INDIA).
Annamalai Univ., Annamalainagar (India). Centre of Advanced Study in Marine Biology.
For primary bibliographic entry see Field 2H.
W90-00409

AUTECOLOGY OF VIBRIO VULNIFICUS AND VIBRIO PARAHAEMOLYTICUS IN TROPICAL WATERS.
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
For primary bibliographic entry see Field 5B.
W90-00427

STUDY OF METAL POLLUTION (CD, CU, PB, ZN) ALONG THE ATLANTIC COAST OF MOROCCO BETWEEN KENITRA AND TEMARA (ETUDE DE LA POLLUTION METTALLIQUE (CD, CU, PB, ZN) DU LITTORAL ATLANTIQUE MAROCAIN ENTRE KENITRA ET TEMARA).
Mohammed V Univ., Rabat (Morocco). Lab. de Microbiologie.
For primary bibliographic entry see Field 5B.
W90-00444

STUDY OF THE SEDIMENTOLOGICAL AND RHEOLOGICAL PROPERTIES OF FLUID MUD IN THE FLUVIO-ESTUARINE SYSTEM OF THE GIRONDE ESTUARY.
Direction de l'Amenagement et de l'Environnement, Bordeaux (France).
For primary bibliographic entry see Field 2J.
W90-00518

NUMERICAL MODELLING OF THE VERTICAL TIDAL CURRENT AND SALINITY STRUCTURE IN A DEEP WATER SCOTTISH LOCH.
Bradford Univ. (England). Dept. of Civil Engineering and Structural Engineering.
R. A. Falconer, and I. C. S. Cox.
Ocean & Shoreline Management, Vol. 12, No. 1, p 61-80, 1989. 11 fig, 1 tab, 15 ref.

Descriptors: *Model studies, *Scotland, *Tidal currents, *Mathematical models, Fjords, *Salinity currents, Bathymetry, Wind-driven currents, Coasts, Eddy viscosity.

A mathematical model was developed to predict the vertical distribution of currents and salinity, along with the water surface slope, in relatively deep shoreline basins where the effects of tidal and wind action are dominant. The model includes an irregular finite difference grid representation at the free surface, thereby describing the movement of the free surface more accurately. The model was verified against the analytical solutions for three idealized test cases, and then applied to Loch Eil, in Scotland, a deep fjordic basin with a narrow and shallow entrance. The model results confirmed that the deepest water was only partially renewed under spring tide conditions, with little or no deep water renewal occurring during neap tides. The complex hydrodynamic circulation predicted within Loch Eil using this mathematical model highlights the potential benefits of using such models for deep water coastal basin management where stratification effects cannot be ignored. The model results exhibited a 'cell-like' structure near locations of relatively abrupt bathymetric changes, and this effect was attributed to the inclusion of a constant eddy viscosity rather than an eddy viscosity representation which varied with the local mean depth. Variations in the bed-roughness coefficient appeared to have little influence on the velocity pattern although the circulation strength was noticeably dependent upon the choice of the eddy viscosity coefficient. The circulation strength was also found to be markedly dependent upon the wind speed and direction, with the results obtained being consistent with field observation described in the literature. (Author's abstract)
W90-00519

CONTRIBUTION OF PICOPLANKTON TO PRIMARY PRODUCTION AND THE CONTENT OF CHLOROPHYLL 'A' IN EUTROPHIC WATERS AS EXEMPLIFIED BY SEVASTOPOL BAY.
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 2H.
W90-00547

TRACE ELEMENTS IN THE ECOSYSTEM OF PETR VELIKIY GULF.
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
For primary bibliographic entry see Field 5B.
W90-00549

HUMIC SUBSTANCES ISOLATED FROM SPARTINA ALTERNIFLORA (LOISEL.) FOLLOWING LONG-TERM DECOMPOSITION IN SEA WATER.
Bundesgesundheitsamt, Langen (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
Z. Filip, and J. J. Alberts.
Science of the Total Environment STENDL, Vol. 83, No. 3, p 273-285, July 15, 1989. 6 fig, 4 tab, 31 ref.

Descriptors: *Humic acids, *Spartina, *Intertidal areas, *Salt marshes, *Marsh plants, Decomposition, Sediments, Infrared spectroscopy, Ultraviolet radiation.

Whether or not there are humic-like substances in Spartina alterniflora which remain in the plant tissue during long-term decay of the plant fragments in sea water that could contribute directly to the pool of humic material in the salt marsh sediment was investigated. Fragments of fresh or dead Spartina alterniflora which were decomposed for 10 months in sea water yielded appreciable amounts of humic substances when extracted with alkali under nitrogen. The plant materials inoculated with mixed populations of epiphytic or mud microorganisms indigenous to the salt marsh yielded up to 168% more humic substances than controls. The results of elemental analyses, including atomic ratios for some elements, and also ultraviolet and Fourier-transform infrared (FTIR) spectroscopy investigation, indicate a great similarity between humic substances from the decomposing S. alterniflora and salt marsh humic acid. Calculations based on the experimental data indicate a potential annual input of approximately 330 kg of fresh Spartina-related humic substances per hectare of salt marsh. (Author's abstract)
W90-00559

PHOTOSYNTHESIS OF SALT MARSH SPECIES.
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 2H.
W90-00605

YANGTZE BRACKISH WATER PLUME: CIRCULATION AND DIFFUSION.
Academia Sinica, Qingdao (China). Inst. of Oceanology.
W. Wensu.
Progress in Oceanography POCNA8, Vol. 21, No. 3-4, p 373-385, 1988. 7 fig, 7 ref.

Descriptors: *River mouth, *Yangtze River, *Rivers, *Brackish water, *Plumes, *Water circulation, *Water currents, *Wind-driven currents, *Salinity, Mathematical models, Momentum equation, Continuity equation, Finite difference methods, Advection, Diffusion, China.

A system of 3-D linearized momentum equations, the continuity equation and a simplified equation of state for sea water were analytically solved for the Yangtze River. The solution comprises 3 parts. The first part is a wind-driven current, the second a jet-like current caused by Yangtze River outflow and the last a density flow. The computed current velocity is obtained by solving an advection-diffusion equation of salinity by a finite-difference method. The results show that the Yangtze brackish water plume spreads as a large low salinity tongue. At the surface, the turning of the tongue axis is mainly controlled by wind stress, Yangtze runoff and bottom topography. Near the bottom, the axis changes little over the year. At about 10-15 m depth, there is a sharp halocline in summer, but at deeper layers the vertical distribution is almost uniform. The computed salinity distribution agrees fairly well with the observed one. (Author's abstract)
W90-00622

PRELIMINARY STUDY OF THE BASIC HYDROGRAPHIC FEATURES AND THE CURRENT STRUCTURES OFF THE CHANGJIANG RIVER MOUTH IN THE DRY SEASON.
Academia Sinica, Qingdao (China). Inst. of Oceanology.
L. Kentang.
Progress in Oceanography POCNA8, Vol. 21, No. 3-4, p 387-400, 1988. 6 fig, 3 tab, 5 ref.

Descriptors: *River mouths, *Rivers, *Hydrography, *Plumes, *Water circulation, *Water currents, *Wind-driven currents, *Changjiang River, Estuaries, China.

The structure of the Changjiang River plume in the dry season is discussed by using data from CTD and anchor stations obtained since 1980 as well as historical hydrographic data. In the dry season the Changjiang Diluted Water is confined to a narrow band west of 122 deg 30 min E, extends to the south or southeast off the South Passage, and at the surface layer behaves like a quasi-geostrophic current instead of a jet-like current, which is different from what it does in the flood season. The southward Huanghai Coastal Current in winter does not seem to keep its path through the Changjiang Estuary and does not become the southward Donghai Coastal Current as conventionally believed. In fact the Huanghai Coastal Current Water could mix with the Changjiang Diluted Water and the offshore water going northward there. A small warmer tongue in the south of the study area was found in December 1985 and January 1986, which is generated by a northward upwind current east of the southward Donghai Coastal Current. The surface current in the study area is much affected by winds varying with short time scales but not so much by the monthly mean wind field. A pair of small surface eddies was found in January 1986, which were caused by the Taiwan Warm Current and northerly wind. (Author's abstract)
W90-00623

COHESIVE SEDIMENT TRANSPORT: I. PROCESS DESCRIPTION.
Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
For primary bibliographic entry see Field 2J.
W90-00630

COHESIVE SEDIMENT TRANSPORT: II. APPLICATION.
Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
A. J. mehta, W. H. McAnally, E. J. Hayter, A. M. Teeter, and D. Schoellhamer.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1094-1112, August 1989. 3 fig, 1 tab, 58 ref.

Descriptors: *Cohesive sediments, *Sediment transport, *Sedimentation, *Estuaries, *Hydrologic models, *Sediment control, *Hydraulic engineering, Dimensional analysis, Field tests, Cohesion, Reservoirs, Tidal effects, Bays, Navigation canals, Harbors, Piers, Numerical analysis, Physical analysis, Sediment transport, Sedimentation rates, Data collections.

Typical engineering applications involving cohesive sediments in tidal water bodies have been made in bays, estuarial navigation channels, small harbor basins, piers, and wharves. Cohesive sediment problems also occur in reservoirs and in the muddy coast environment. Principal emphasis is placed on estuary-related problems. Techniques for prediction of estuarial sedimentation include field methods, physical and numerical modeling, and hybrid modeling which optimally combines physical and numerical modeling approaches. In many cases simple, zero-dimensional modeling yields results of acceptable accuracy. Three-dimensional numerical models have recently been developed for analyzing situations in which the complex structure of flows and associated sediment motion cannot be simplified. Further progress in improving the accuracy of prediction of sediment rates can be made by better understanding the basic laws governing cohesive sediment behavior, and by developing new strategies and instrumentation for data collection. (Author's abstract)
W90-00631

EFFECTS OF ZINC/SALINITY COMBINATIONS ON ZINC REGULATION IN GAMMARUS DUEBENI FROM THE ESTUARY AND THE SEWAGE TREATMENT WORKS AT LOOE, CORNWALL.
Plymouth Polytechnic (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W90-00634

EELGRASS PRODUCTIVITY ON AN INTERTIDAL FLAT OF CENTRAL JAPAN.
Tokai Regional Fisheries Research Lab., Tokyo (Japan).
For primary bibliographic entry see Field 2I.
W90-00670

NUTRIENTS STATUS IN A EUTROPHIC MEDITERRANEAN LAGOON.
National Centre for Marine Research, Athens (Greece).
N. Friligos.
Vie et Milieu (Life and Environment), Vol. 39, No. 2, p 63-69, June 1989, 6 fig, 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Nutrients, *Plankton, *Biomass, *Lagoons, *Greece, Red tide, Salinity, Water temperature, Dissolved oxygen, Mediterranean Sea.

Seasonal variation in temperature, salinity, dissolved oxygen, nutrients and chlorophyll a were studied at sixteen stations in the eutrophic Messolonghi Lagoon during 1983-1984. Algae, rainfall and winds were the most important factors affecting nutrient fluctuations over space and time. The level of eutrophication was generally acceptable in nearly all the area; serious pollution occurred only in the most northerly section of the lagoon below 10 m (causing anoxic conditions) and in the area close to the point of discharge of the city sewage. (Author's abstract)
W90-00671

PRESENT STATE OF SEAWEED PRODUCTION ALONG THE ROMANIAN BLACK SEA SHORE.
Institutul Roman de Cercetari Marine, Constanta (Romania).
A. S. Bologa.
Vie et Milieu (Life and Environment), Vol. 39, No. 2, p 105-109, June 1989, 1 fig, 3 tab, 18 ref.

Descriptors: *Macrophytes, *Algae, *Benthic flora, *Biomass, *Productivity, Phaeophyta, Rhodophyta, Black Sea, Romania, Species diversity.

Along the Romanian Black Sea shore the rocky bottom which is a substrate for benthic seaweeds, is discontinuous and variable in width. These macrophytes have endured a gradual, but continuous qualitative and quantitative decline since the period 1946-1950, due to both natural and anthropogenic factors. The large belts of Cystoseira have practically disappeared as well as those of numerous other Phaeophtya and Rhodophyta species. The present algal flora, which displays a reduced species diversity, is uniform and is mainly dominated by species of Enteromorpha and Ceramium. These dominant species, with short and more or less seasonal life cycles, display considerable production and degrees of cover up to 80%; nevertheless, they do not reach those of the Cystoseira belts from previous decades. (Author's abstract)
W90-00673

NUTRIENT-ENHANCED GROWTH OF CLADOPHORA PROLIFERA IN HARRINGTON SOUND, BERMUDA: EUTROPHICATION OF A CONFINED, PHOSPHORUS-LIMITED MARINE ECOSYSTEM.
Harbor Branch Oceanographic Institution, Inc., Fort Pierce, FL.
B. E. Lapointe, and J. O'Connell.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 4, p 347-360, April 1989, 5 fig, 4 tab, 35 ref. NSF Grant No. OCE-8515492.

Descriptors: *Cladophora, *Eutrophication, *Algae, *Nitrogen, *Phosphorus, *Nutrients, *Productivity, *Marine environment, *Bermuda, Alkaline phosphatase, Photosynthesis, Harrington Sound, Enzymes.

This study assesses the nutrient-dependance of productivity of Cladophora collected from Harrington Sound, a confined phosphorus limited marine system where Cladophora first became abundant. Both nitrogen and phosphorus enrichment decreased the doubling time of Cladophora, which ranges from 14 days (with nitrogen and phosphorus enrichment) to 100 days (without enrichment). Nutrient enrichment also enhanced the light-saturated photosynthetic capacity of Cladophora. Tissue C:N, C:P and N:P ratios of unenriched Cladophora were elevated. The levels suggest limitation by both nitrogen and phosphorus but primary limitation by phosphorus. Pore-waters under Cladophora mats had reduced salinities, elevated concentrations of NH4, and high N:P ratios, suggesting that nitrogen-rich groundwater seepage enriches Cladophora mats. The alkaline phosphatase capacity of Cladophora was high compared to other macroalgae in Harrington Sound, and its capacity was enhanced by nitrogen enrichment and suppressed by phosphorus enrichment. Because the productivity of Cladophora is nutrient limited in shallow waters of Harrington Sound, enhanced growth and increased biomass of Cladophora result from cumulative seepage of nitrogen rich groundwaters coupled with efficient utilization and recycling of dissolved organo-phosphorus compounds. (Author's abstract)
W90-00676

NEGATIVE ROLE OF TURBULENCE IN ESTUARINE MASS TRANSPORT.
University Coll., Campbell (Australia).
R. A. Nunes Vaz, G. W. Lennon, and J. R. de Silva Samarasinghe.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 4, p 361-377, April 1989, 7 fig, 40 ref.

Descriptors: *Estuaries, *Stratification, *Turbulent flow, *Density currents, *Quantitative analysis, Mass transport, Dispersion, Tides, Seasonal variation.

Borrowing concepts which have been successfully applied to the discussion of stratification in shelf seas, a qualitative basis for determining the potential energy associated with vertical structure in estuaries is derived. The formulation, along similar lines to that of Bowden, provides a simple but comprehensive method of incorporating many relevant stratifying and mixing influences in a given problem, and is also shown to be capable of rearrangement into forms akin to the estuarine Richardson number which is commonly found in discussions of estuarine stratification. This paper argues, based on a survey of the literature, that in wide, relatively well-mixed estuaries, the greatest longitudinal mass flux occurs at times when stratification is most developed, that is, when the turbulent kinetic energy in the water column is at a minimum. Modulation of turbulence, principally at various tidal frequencies, causes a pulsing of the mass flux in which the contribution of each pulse increases non-linearly as the period of the modulation increases. Some, possibly significant, changes to the state of stratification and to the corresponding mass transport may occur in association with slack waste periods. However, the spring-neap cycle is proposed to have a far greater influence on stratification, mass transport and the long-term mass balance in estuaries, and recent observational studies lend support to this position. (Author's abstract)
W90-00677

GEOCHEMISTRY OF BERYLLIUM-7 IN CHESAPEAKE BAY.
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
J. E. Dibb, and D. L. Rice.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 4, p 379-394, April 1989, 9 fig, 7 tab, 12 ref. NSF Grants Nos. OCE 8442759 and OCE 8511383.

Descriptors: *Beryllium, *Chesapeake Bay, *Radioisotopes, *Geochemistry, Water columns, Retention, Adsorption, Seston, Sediment transport.

The dissolved and particulate activities of (7)Be in surface and deep water samples from four stations in the main stem of Chesapeake Bay were determined seven times between April, 1986 and April, 1987. Total water concentrations ranged from less than 0.05 to 3.86 dpm/L, with an average of 0.05 dpm/L. Batch adsorption experiments indicated a strong affinity of beryllium for Chesapeake Bay seston, but (7)Be in the Bay was predominately in the dissolved phase. Particulate (7)Be activities reached 150 dpm/g, but averaged 18 dpm/g, suggesting that rapid variations in the supply of both (7)Be and suspended particulates rarely allowed equilibrium partitioning of (7)Be between the dissolved and particulate phases. A (7)Be budget for Chesapeake Bay indicated that atmospheric deposition was always the dominant source of (7)Be in the Bay. Generally, 95% or more of the (7)Be delivered to the bay was retained by it. Most (usually greater than 80%) of the (7)Be in Chesapeake Bay at any time was found in the sediments. (See also W90-00679) (Author's abstract)
W90-00678

TEMPORAL AND SPATIAL DISTRIBUTION OF BERYLLIUM-7 IN THE SEDIMENTS OF CHESAPEAKE BAY.
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
J. E. Dibb, and D. L. Rice.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 4, p 395-406, April 1989. 4 fig, 5 tab, 20 ref. NSF grants OCE 8442759 and OCE 8511383.

Descriptors: *Geochemistry, *Beryllium, *Chesapeake Bay, *Radioisotopes, *Sedimentation, *Distribution, Spatial distribution, Temporal distribution.

The sediment inventory of (7)Be was determined at six stations in the main stem of Chesapeake Bay nine times between April 1986, and September, 1987. The inventories ranged from less than 0.02 to

7.32 dpm/sq cm. Comparison to the atmospherically supported (7)Be inventory (range 2-4 dpm/sq cm) showed significant focusing of (7)Be in the sediments in the zone of the turbidity maximum during the summer, and suggested that the spatial distribution of (7)Be in the sediments of the lower Bay was determined largely by horizontal redistribution of bottom sediments. The process causing this redistribution of (7)Be in the lower Bay apparently had a recurrence frequency greater than the sampling frequency in this investigation. The temporal pattern of (7)Be accumulation at the six stations over the first year of this investigation allowed estimation of sedimentation rates, which suggested that the process governing the distribution of (7)Be in Chesapeake Bay sediments were similar to the processes determining sedimentation patterns over about the past 100 years. (See also W90-00678) (Author's abstract)
W90-00679

NATURAL VARIATIONS IN NITROGEN-15 CONTENT OF RIVERINE AND ESTUARINE SEDIMENTS.
Marine Biological Association of the United Kingdom, Plymouth (England).
N. J. P. Owens, and C. S. Law.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No.4, p 407-416, April 1989. 4 fig, 1 tab, 35 ref.

Descriptors: *Tracers, *Sediment transport, *Rivers, *Estuaries, *Isotope studies, *Sedimentation, *Nitrogen, England.

A study of natural variations of delta (15)N in the sediments of the river Tamar estuary and its catchment, south-west England, is described. The mean delta (15)N content for freshwater sediments was + 2.3 ppt and distinct from the majority of estuarine sediments. Three catchment areas that together comprise the riverine system could be distinguished by a combination of the delta (15)N content of the sediments and the riverine NO3(-) concentrations. Estuarine surface sediments fell into three groups: upper-estuary, mid-estuary, and lower-estuary. These distributions confirm earlier, non-isotopic, observations of the complex patterns of transportation of surface sediments in this estuary. (Author's abstract)
W90-00680

SUBTIDAL ADVECTIVE WATER FLUX AS A POTENTIALLY IMPORTANT NUTRIENT INPUT TO SOUTHEASTERN U.S.A. SALT-MARSH ESTUARIES.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
G. J. Whiting, and D. L. Childers.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 4, p 417-431, April 1989. 8 fig, 3 tab, 30 ref. NSF Grant No. BSR8119752.

Descriptors: *Estuaries, *Advection, *Nutrients, *Salt marshes, Water columns, Sediments, Interstitial water, Hydrology.

An initial study was conducted to assess the importance of the advective movement of interstitial water from subtidal creek sediments in enriching the overlying creek water of the estuary. The process of advection was measured in two creeks of a South Carolina estuarine saltmarsh and results indicated that significant amounts of inorganic nutrients (NH4(+) and PO4(3-)) were added to the overlaying creek water by this process. The nutrient concentrations in the advected water were as much as an order of magnitude higher than in the overlying water column. A comparison of runoff from the marsh surface during low tide to advection from subtidal creek bottoms indicated the importance of the latter in contributing NH4(+) and PO4(3-) to the estuarine water column. Data indicated, however, that runoff from the marsh surface appeared to be a greater source of NO3(-) + NO2(-) to the tidal creek waters. Mean advective flux across one of the creeks was 6 times and 2.5 times higher for NH4(+) and PO4(3-), respectively, than surface runoff (a process known to export nutrients to tidal creek water) from the nearby vegetated marsh. When normalized over the areal extent of subtidal creek bottom in the estuary, subtidal advection is estimated to contribute approximately three times as much NH4(+) and 1.3 times as much PO4(3-) to the estuarine water column than low tide runoff from the vegetated marsh surface. (Author's abstract)
W90-00681

DETERMINATION OF THE ISOTOPIC COMPOSITION OF AMMONIUM-NITROGEN AT THE NATURAL ABUNDANCE LEVEL FROM ESTUARINE WATERS.
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W90-00693

HYDRO-SEDIMENTOLOGY OF THE JOHNSTONE RIVER ESTUARY.
Queensland Inst. of Tech., Brisbane (Australia). Dept. of Applied Geology.
A. V. Arakel, C. M. Hill, J. Piorewicz, and T. B. Connor.
Hydrobiologia HYDRB8, Vol. 176/17, p 51-60, July 3, 1989. 2 fig, 4 tab, 9 ref.

Descriptors: *Estuaries, *Johnstone River Estuary, *Sedimentation, *Aggradation, *Sediment erosion, *Erosion, *Australia, Hydrologic data, Geologic history, Model studies, Numerical analysis.

Historical, sedimentological and hydrological data are combined with one dimensional numerical modelling, in an effort to document and quantify sediment aggradation/erosion in the Johnstone River estuary, Australia and the tidal reaches of the South Johnstone river. Historical comparison and field observations show an average aggradation rate in the lower South Johnstone river from 1942 to 1983 of approximately 100,000 tons per annum. however, due to a significant expansion of sugar cane farming into erosion prone lands, since 1975, a more realistic aggradation rate (based on evaluations from 1977 to 1983) suggests a rate of 3 times this amount; that is approximately 300,000 tons per annum. This river aggradation reflects cane-land erosion rates of 150 tons per hectare per annum which equate to an annual soil loss of up to 823,000 tons in the catchment. Preliminary sedimentological studies indicate that the effects of cane land erosion, while of great significance in the tributary creeks, may not be as important in river aggradation. The results of one-dimensional sediment (sand) modelling suggest that, under average conditions, major aggradation is confined to the lower Johnstone river with minimal sedimentation in the estuary. This tendency is confirmed by first hand and historic observations of the formation of large sand spits and islands within the river. (Miller-PTT)
W90-00700

RESUSPENSION, EPHEMERAL MUD BLANKETS AND NITROGEN CYCLING IN LAHOLMSBUKTEN, SOUTH EAST KATTEGAT.
Uppsala Univ. (Sweden). Naturgeografiska Inst.
S. Floderus, and L. Hakanson.
Hydrobiologia HYDRB8, Vol. 176/17, p 61-75, July 3, 1989. 11 fig, 1 tab, 40 ref.

Descriptors: *Coastal waters, *Nitrogen cycle, *Suspension, *Ephemeral lakes, *Eutrophication, Model studies, Sinks, Mud blankets.

Primary production on coastal waters is generally nitrogen-limited due to the efficient nitrogen sink pathways, which therefore limit further eutrophication. In this context, the significance of ephemeral mud blankets at shallow depth has been characterized using a simple computational box model. Bed materials from several synoptic grab-sample surveys in Laholmsbukten, a shallow embayment of the Kattegat Sea, were analyzed. Sediment trap and current meter data provided an assessment of fine material transport; the frequency of loose mud resuspension was estimated to vary between three and ten events per month in the spring, depending on the wind conditions. Mud blankets appear to be deposited following major spring and fall phytoplankton blooms, they are only a few centimeters thick, they are composed mainly of pelletized organic material and detritus and they have a high water content (80% wet weight) and nitrogen content (0.5% dry weight). In the course of export from the bay, the muds undergo continuous resuspension, redeposition and biological breakdown. In one September day, the amount of particulate nitrogen redeposited in sediment traps was of equivalent magnitude to the entire mud blanket deposit (5 g N/sq m or a 4 mm deposit as a bay-wide mean). The presence of mud blankets is believed to control the nitrogen budget and water quality in the bay. Calm conditions are conducive to the loss of bound nitrogen and free oxygen within the bay as a result of prolonged denitrification. If fine particles are rapidly exported from shallow bottoms, as in windy ponds, the water quality of the entire Kattegat Sea is likely to be impaired. (Author's abstract)
W90-00701

ENVIRONMENTAL INVESTIGATION OF A MARINE COASTAL AREA: GULF OF GAETA (TYRRHENIAN SEA).
ENEA, La Spezia (Italy). Centro Richerche Energia Ambiente.
O. Ferretti, I. Niccolai, N. Bianchil, S. Tucci, and C. Morri.
Hydrobiologia HYDRB8, Vol. 176/17, p 171-187, July 3, 1989. 11 fig, 1 tab, 23 ref.

Descriptors: *Marine environment, *Suspended sediments, *Sedimentation, *Coastal waters, *Particulate matter, *Aggrading rivers, Gulf of Gaeta, Statistical analysis, Seasonal variation, Italy.

The processes responsible for the transport of terrigenous particulate matter are considered together with the influence of this particulate matter on the benthic communities of the area. Two rivers in Italy, the Garigliano to the north and the Volturno to the south, determine the extent of major environmental sub-zones in the Gulf of Gaeta. The first, influenced by the Garigliano River, is restricted to the northern and inner part of the gulf, where morphological and hydrodynamical conditions favor siltation. The second sub-zone is mainly influenced by the Volturno River, which affects a very large area, spreading both north and south along the coast and up to 15 km offshore. To achieve a better understanding of the sedimentary environment of the Gulf of Gaeta, seasonal and spatial variations of suspended matter concentrations, elemental composition and mineralogy were determined and their sources identified. Both the composition and size of suspended matter are seasonally variable. In summer, the organic fraction predominates; the mineral load of land drainage is low but its organic content is relatively high, and primary production in coastal waters is also high. In winter, the inorganic component predominates. Cluster analysis was carried out to explore possible relationships between grain size and the sedimentary environment. The samples were found to be grouped in three clusters in both seasonal simulations. Measured levels of trace elements appear to be considered close to natural concentrations. The benthic communities of the northern sub-zone indicates generally stressed condition due to siltation by the Gargiano River input. These communities occur in an area rich in organic matter which does not appear to be completely recycled. Anthropogenic contamination appears to be related to the effects of agricultural practices on the alluvial plains and to the presence of urban settlements. (Miller-PTT)
W90-00709

MERCURY POLLUTION IN TOKUYAMA BAY.
Yamaguchi Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00711

NICKEL SORPTION AND SPECIATION IN A MARINE ENVIRONMENT.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 5B.

W90-00713

NUTRIENT REMOBILIZATION PROCESSES AT THE TIBER RIVER MOUTH (ITALY).
Istituto di Ricerca sulle Acque, Rome (Italy).
For primary bibliographic entry see Field 5B.
W90-00719

SIMULATION OF THE PROCESS OF SEDIMENTATION OF SUSPENDED SOLIDS IN THE YOSHII RIVER ESTUARY.
National Research Inst. for Pollution and Resources, Yatabe (Japan).
For primary bibliographic entry see Field 2J.
W90-00730

AQUATIC POLLUTION IN THE FAR EAST.
Aquatic Habitat Inst., Richmond, CA.
For primary bibliographic entry see Field 5B.
W90-00739

POLLUTION OF THE COASTAL WATERS OF HONG KONG.
Hong Kong Univ. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W90-00740

TRACE METALS AND ORGANOCHLORINES IN THE COASTAL WATERS OF HONG KONG.
Aquatic Habitat Inst., Richmond, CA.
For primary bibliographic entry see Field 5B.
W90-00741

ENVIRONMENTAL IMPACT OF AQUACULTURE AND THE EFFECTS OF POLLUTION ON COASTAL AQUACULTURE DEVELOPMENT IN SOUTHEAST ASIA.
International Center for Living Aquatic Resources Management, Manila (Philippines).
For primary bibliographic entry see Field 5C.
W90-00744

PERSISTENT ORGANOCHLORINES IN JAPANESE COASTAL WATERS: AN INTROSPECTIVE SUMMARY FROM A FAR EAST DEVELOPED NATION.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5B.
W90-00745

SPATIAL AND TEMPORAL VARIABILITY IN SOUTH SAN FRANCISCO BAY (USA). I. HORIZONTAL DISTRIBUTIONS OF SALINITY, SUSPENDED SEDIMENTS, AND PHYTOPLANKTON BIOMASS AND PRODUCTIVITY.
California Univ., Davis. Div. of Environmental Studies.
T. M. Powell, J. E. Cloern, and L. M. Huzzey.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 6, p 583-597, June 1989. 11 fig. 1 tab. 41 ref.

Descriptors: *San Francisco Bay, *Salinity, *Suspended solids, *Primary productivity, *Estuaries, *Phytoplankton, Biomass, Spatial distribution, Current patterns.

A study of primary productivity in the South San Francisco Bay estuary during the spring of 1987 found that the horizontal pattern of mesoscale (1-4 km) variability in salinity was a poor predictor of mesoscale patterns in chlorophyll a, suspended particulate matter, and daily primary productivity. The tidally-averaged salinity distribution varied over weekly time scales, reflecting inputs of freshwater as well as transport processes. Spatial distributions of the other quantities also varied weekly, but not in conjunction with the salt field. Spatial patterns of phytoplankton biomass (chlorophyll a) deviated from the salinity patterns, largely reflecting in situ production of phytoplankton biomass during the spring bloom. The tidally-averaged distribution of suspended particulate matter (SPM) was highly dynamic and responded to (1) the riverine input of suspended sediment during a freshet, (2) neap-spring variations in tidally-driven resuspension, and (3) resuspension in shallows following a period of wind mixing. Two-dimensional distributions of primary productivity P', derived from maps of biomass and turbidity (SPM), also varied weekly, but the spatial variability of P' was only about half that of SPM and chlorophyll. Since the magnitude and patterns of spatial variability differ among nonconservative quantities, at least in part because of local sources and sinks, it was concluded that the spatial distributions of nonconservative quantities cannot be predicted from distributions of conservative tracers, such as salinity. (Author's abstract)
W90-00784

SPATIAL AND TEMPORAL VARIABILITY IN SOUTH SAN FRANCISCO BAY (USA). II. TEMPORAL CHANGES IN SALINITY, SUSPENDED SEDIMENTS, AND PHYTOPLANKTON BIOMASS AND PRODUCTIVITY OVER TIDAL TIME SCALES.
Geological Survey, Menlo Park, CA.
J. E. Cloern, T. M. Powell, and L. M. Huzzey.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 6, p 599-613, June 1989. 8 fig. 1 tab. 37 ref.

Descriptors: *San Francisco Bay, *Suspended sediments, *Salinity, *Primary productivity, *Estuaries, *Phytoplankton, Tides, Advection, Variability, Chlorophyll a.

Short-term variability of a conservative quantity (salinity) and two nonconservative quantities (chlorophyll a, suspended particulate matter) was measured across a sampling grid in the South San Francisco Bay estuary. Surface measurements were made every 2 hr at each of 29 (or 38) sites, on four different dates representing a range of tidal current regimes over the neap-spring cycle. From the distribution of phytoplankton biomass (chlorophyll a) and turbidity (suspended particulate matter SPM), daily productivity and its variability at each site over the four tide cycles was estimated. As a general rule, both chlorophyll a and SPM concentrations varied about 50% from their tidal-means. However derived daily productivity varied less (about 15% from the mean) over a tidal cycle. Both chlorophyll a and SPM varied periodically with tidal stage (increasing on ebbing currents), suggesting that the short-term variability results simply from the tidal advection of spatial gradients. Calculation of the advective flux (current speed times spatial gradient) was used to test this hypothesis. For surface salinity, most (70-80%) of the observed intratidal variability was correlated with the tidal flux, both in the deep channel and over the lateral shoals. However, the short-term variability of SPM concentration was only weakly correlated with the advective flux, indicating that local sources of SPM (resuspension) are important. Hourly changes in chlorophyll a were highly correlated with the advective flux in the deep channel (implying that phytoplankton biomass is a conservative over short time scales there); however, chlorophyll a variability was only weakly correlated with the advective flux over the shoals, implying that local sources/sinks are important there. Hence, the magnitude and mechanisms of intratidal variability differ among constituents and among bathymetric regimes in this estuary. (Author's abstract)
W90-00785

TURBULENT MOMENTUM AND SALT TRANSPORT IN THE MIXING ZONE OF THE ELBE ESTUARY.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
M. Schroder, and G. Siedler.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 6, p 615-638, June 1989. 17 fig. 1 tab. 32 ref.

Descriptors: *Saline-freshwater interfaces, *West Germany, *Estuaries, *Tides, *Eddies, Temperature, Velocity, Conductivity, Light penetration, Sensors, Turbulent flow.

Measurements in the mixing zone of the Elbe estuary were performed during three consecutive tidal cycles with three types of instruments--a moored tripod with velocity and temperature/conductivity/light attenuation sensors, a profiling sonde with similar sensors lowered from an anchored vessel, and instrumented moorings. Acoustic-travel-time sensors were used for velocity measurements. Spectral analysis of 12.8 min pieces of the obtained time series gives results that are consistent with isotropic turbulence for part of the frequency space. Temporal changes of turbulent kinetic energy are correlated with tidal current velocity. A retardation is found between changes in tidal current and turbulent energy. Not all shear stress terms are in similar phase with tidal flow. Mean gradients, Reynolds stress terms, and turbulent salt flux terms are combined to determine eddy viscosity and eddy diffusion coefficients. (Author's abstract)
W90-00786

BEHAVIOR OF CD, PB, AND CU IN THE MARINE DELTAIC AREA OF THE PO RIVER (NORTH ADRIATIC SEA).
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 5B.
W90-00815

ORGANIC MARKERS AS SOURCE DISCRIMINANTS AND SEDIMENT TRANSPORT INDICATORS IN SOUTH SAN FRANCISCO BAY, CALIFORNIA.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W90-00854

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

APPLICATION OF THE THRESHOLD CONCENTRATION CONCEPT TO IRRIGATION WITH SALINE WATER.
Victoria Dept. of Agriculture and Rural Affairs, Tatura (Australia). Inst. for Irrigation and Salinity.
P. Rengasamy, and A. H. Mehanni.
Soil Use and Management SUMAEU, Vol. 4, No. 4, p 123-127, December 1988. 3 fig, 2 tab, 9 ref.

Descriptors: *Irrigation efficiency, *Saline water, *Infiltration rate, *Impaired water use, *Rainfall, Adsorption, Permeability, Australia, Evapotranspiration, Soil properties, Vegetation effects, Salts.

The applicability of the threshold concentration concept in formulating guidelines for irrigating with saline water was tested under field conditions on red-brown earths from different field experiments in south eastern Australia. Infiltration of water in the field and the effect of rainfall impact were studied using ring infiltrometers and a rotating-disc rainfall simulator. Three threshold concentration lines relating sodium adsorption ratio and total cation concentration in soil extracts were tested. These lines were based on laboratory tests of soil permeability, spontaneous dispersion and mechanical dispersion. They were found to predict the infiltration problems due to rainfall impact under three different surface soil conditions: bare soil without cultivation, soil with no tillage and complete crop cover, and cultivated soils without any crop cover. Infiltration rates in continuous pasture plots were predicted by the threshold concentration line of spontaneous dispersion except in a high salt treated soil where reduced plant growth affected evapotranspiration and water intake during infiltration. (Author's abstract)
W90-00508

3D. Conservation In Domestic and Municipal Use

DIRECTIONS IN WATER CONSERVATION AND MANAGEMENT IN MASSACHUSETTS.
Massachusetts Water Resources Commission, Boston.
P. A. Garrigan.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 2, p 69-73, June 1989.

Descriptors: *Water conservation, *Massachusetts, *Future planning, *Water policy, Water demand, Water transfer, Water use, Water management, Management planning, Public opinion, Water permits.

Various Massachusetts statutes and regulations that assist in water conservation include: the Water Management Act (MGL Chapter 21G), the Interbasin Transfer Act (MGL Chapter 21, Sect. 8b-8d), and the Water Resources Planning Regulations (313 CMR 2.00). The statutes and regulations are designed to implement policies adopted by the Massachusetts Water Resources Commission, the State's water policy and planning body which is chaired by the secretary of Environmental Affairs. One policy set forth by the Commission is to better manage the demand for water through water conservation. To encourage water conservation, the Commission adopted Components of a Minimum Water Conservation Plan in October 1987. This document outlines what a local water conservation plan should cover. To assist in completing this plan the Commission, with the help of other state agencies, developed Guidelines for Preparing a Water Conservation Plan. The guidelines include a water conservation questionnaire, recommended actions and reference materials. A public water supplier, or community will go through this questionnaire as part of the process of applying for a water withdrawal permit under the Water Management Act. In addition to helping develop a plan of action for conservation, completing the exercise can give towns priority consideration for state grants. The Massachusetts Water Resources Authority has launched a comprehensive water conservation program to reduce the demand for water through a program of leak detection and repair, meter inspection, and an outreach program for material distribution. The Department of Environmental Quality Engineering recently analyzed the first round of newly required testing for 59 volatile organic chemicals for systems serving over 10,000 people. The Massachusetts Water Management Act of 1984 provides for registration of existing withdrawals, permitting of new withdrawals and emergency declarations giving more authority to the supplier to enforce emergency measures. The Massachusetts Interbasin Transfer Act gives the Water Resources Commission the mandate to approve or disapprove any significant transfer of surface and groundwater, including wastewater, outside a river basin. (Geiger-PTT)
W90-00651

OVERVIEW OF THE MWRA WATER CONSERVATION PROGRAM.
Massachusetts Water Resources Authority, Boston. Resource Conservation and Management.
M. Kempe.
Journal of the New England Water Works JNEWA6, Vol. 103, No. 2, p 74-85, June 1989. 5 fig, 1 append.

Descriptors: *Water conservation, *Water supply, *Drinking water, *Water management, *Massachusetts, Water distribution, Water use efficiency, Domestic water, Education, Water demand, Management planning.

The Massachusetts Water Resources Authority (MWRA) was established in 1985 as an independent public authority. The MWRA assumed responsibility for delivery and distribution of water as well as collection and treatment of sewage for the metropolitan Boston area. MWRA is charged with providing efficient and economical water supply and sewage disposal services for over 2.5 million people in 60 communities. The agency's main objectives include the cleanup of Boston Harbor, improvements to the aging water and sewerage infrastructure, provision of pure and adequate drinking water and promotion of water conservation. MWRA is the wholesale distributor of water to 46 cities and towns. It oversees approximately 130 miles of large aqueducts and 260 miles of large diameter distribution pipelines. Distribution of water to consumers within the communities is the responsibility of the local water departments. The MWRA supplied communities have traditionally been responsible for consumer related activities (e.g. metering, billing, water conservation) as well as maintaining the efficiency of their own distribution systems. Facets of the MWRA's Demand Management Program include: metering, leak detection, pricing, public education, school program, nondomestic program, residential program, municipal program, drought management plan, prevention of water supply loss, pipeline and aqueduct rehabilitation, and watershed management programs. Water conservation materials available from MWRA are described. (Geiger-PTT)
W90-00652

3F. Conservation In Agriculture

NEED FOR CLIMATIC AND HYDROLOGIC DATA IN AGRICULTURE IN SOUTHEAST ASIA.
For primary bibliographic entry see Field 7A.
W90-00100

APPLICATION OF CLIMATIC AND HYDROLOGICAL DATA IN STABILIZING PRODUCTION SYSTEMS IN THE HUMID AND WET-DRY TROPICS OF ASIA.
Agrarian Research and Training Inst., Colombo (Sri Lanka).
C. R. Panabokke.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 3-8, 1 tab, 8 ref.

Descriptors: *Data collections, *Water resources data, *Climatology, *Hydrologic data, *Tropical regions, *Agricultural hydrology, Rainfall, Crop production, Solar radiation.

Approximately 80% of the cultivated area in eight countries of South and Southeast Asia is dependent on rain because irrigation is very limited. The major rainfed agricultural production systems comprise: (1) rainfed shifting cultivation; (2) rainfed settled arable farming; and (3) rainfed perennial tree crops. Cultivation of perennial crops is mainly confined to the rainfall regime of the humid tropics. Settled arable farming occurs mainly within the rainfall regime of the wet-dry tropics. Shifting cultivation takes place in both rainfall regimes. Production of rainfed arable crops in these rainfall regimes is more difficult and complex than in the rainfed areas of the temperature climates. In the wet-dry tropics especially, both a deficiency and excess of rain contributes to instability in agricultural production. Highly commercialized plantation agriculture with perennial tree crops in the humid tropics is, however, a more stable production system. One of the more important problems in the stabilization of rainfed agriculture in the wet-dry tropics is the development of systems that would ensure an optimum use of the incident rainfall. This would principally involve: (1) a proper choice of sowing time and (2) a proper selection of sowing-to-harvest duration of crops so that there is a maximum likelihood of the rainfall satisfying the crop water demand at most stages of growth and development. Having specified the sequential rainfall probability pattern during the growing season, and with a knowledge of the water consumption pattern of crops during their growth, the main strategy would therefore be to tailor the crops to rainfall and adjust their management to the available sequences of soil moisture. There is a lack of long-term data on global solar radiation for some regions. A proper characterization of the seasonality and variability of global solar radiation would assist agronomists and plant breeders to match the different growth phases of cultivars to the seasonal rhythm of global solar radiation with a view to capturing the maximum benefits of its interaction with the yield components of cultivars. (See also W90-00100) (Author's abstract)
W90-00101

PROBLEMS RELATED TO THE EFFECTS OF ENVIRONMENTAL CONDITIONS ON THE IMPROVEMENT OF AGRICULTURE IN SOUTH-EAST ASIA.
Snowy Mountains Engineering Corp., Cooma (Australia).
W. B. J. Withers.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 9-15, 2 tab.

Descriptors: *Data collections, *Water resources data, *Agricultural hydrology, *Asia, *Climatology, *Hydrologic budget, Irrigation, Seasonal variation, Hydrologic data, Water use, Rainfall, Flood peak, Rainfall-runoff relationships.

Typically the climate of southeast Asia has wet and dry seasons with requirements for comprehensive water management, including irrigation and drainage, both in the field and in the channel system. Problems to agriculture are those stemming from water being in the wrong place at the wrong time. Excess water may be due to the intensity of rainfall or the flooding of streams. Problems to the engineer trying to alleviate conditions for farming stem from the inadequacy or unreliability of data. For irrigation design the need is to assess crop water use, effective rainfall, efficiency of water use, peak flow and annual water requirements. In these matters errors in assessing the human factor tend to outweigh errors due to poor data. For irrigation supplies, flood protection and drainage, the need is to know the pattern of streamflow. For drainage it is necessary to also know the frequency/intensity/duration characteristics of rainfall and rainfall/runoff relationships. In these matters the often met inadequacy of data can seriously affect the cost or effectiveness of the engineering work and their value to the farmer. Automated systems of data collection and processing are not generally of great practical benefit, but there are particular circumstances in which sophisticated equipment is invaluable. (See also W90-00100) (Author's abstract)
W90-00102

MINIMUM DATA SETS: HYDROLOGICAL APPLICATIONS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
P. M. Fleming.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 21-34, 5 tab, 22 ref.

Descriptors: *Data collections, *Water resources data, *Hydrologic data, *Agricultural hydrology, Data acquisition, Irrigation, Drainage, Hydrologic budget, Flood protection, Agriculture.

The collection and archiving of climatic and hydrologic data without an explicit program of application of that data is often unrewarding to the persons collecting and even to the data collecting agency. It is also counterproductive to the maintenance of accurate data sets. Minimum data sets, in particular, must be specified in the context of explicit applications. This paper concentrates on applications involving hydrologic aspects of planning agricultural development at the individual project

level. It is basically about problems in agricultural hydrology. The major concern is with respect to the assessment of irrigation requirements in space and time, the design of irrigation supply channels and associated surface and subsurface drainage works. Drsinage works associated with rainfed agriculture are also addressed. Data requirements with respect to assessment of groundwater quantity and quality for use in both irrigation and domestic supplies are considered and those associated with prediction of groundwater response to changes in hydrologic regime as a result of agricultural development. Hydrologic data necessary for flood hazard assessment and the design of flood mitigation and control schemes are discussed at the project level, but not those required for river basin planning or the design of major flood control or river dams and structures. Finally some reference is made to data requirements in the operational mode of agricultural water supply and drainage projects and for monitoring potential environmental hazards. The viewpoint adopted will be that of the project manager or operations engineer. (See also W90-00100) (Author's abstract)
W90-00103

APPLICATION OF AGROMETEOROLOGICAL INFORMATION IN RELATION TO RICE-BASED CROPPING PATTERNS IN SOUTH-EAST ASIA.
International Rice Research Inst., Los Banos, Laguna (Philippines).
L. R. Oldeman.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 41-52, 4 fig, 1 tab, 24 ref.

Descriptors: *Data collections, *Water resources data, *Agricultural hydrology, *Meteorology, *Crop production, *Rice, Hydrologic budget, Rainfall, Developing countries, Climatology, Rainfall, Seasonal variation, Evapotranspiration, Hydrologic models.

Climatic conditions in Southeast Asia are generally suitable for rice based cropping patterns. Major limitations are the uncertainty of the onset and end of the rainy season and the occurrence of dry spells during the cropping seasons. Methodologies to assess the limitations of climate, i.e., rainfall, generally use long-term daily rainfall records. This information is generally difficult to retrieve. It is therefore important to simplify existing methodologies so that longer period rainfall totals, such as weekly or 10-day totals can be used without losing too much accuracy. Since rainfall regimes show great variation in space and time, a simple classification system for rice based cropping systems has been developed using the concept of the length of consecutive wet and dry periods. Rainfall distribution maps were prepared for Indonesia, the Philippines, Bangladesh, and Thailand. The growing season, defined as the period during the year that sufficient water is available to the crop, should be based on a cumulative soil-water balance model that takes into account not only the atmospheric water balance (i.e., rainfall vs. actual evapotranspiration) but also the soil physical characteristics and the landscape position to assess surface and subsurface hydrology. Existing models to describe the soil water balance require input data that are seldom available on a large scale. A model should be developed that gives reasonable estimates on length of growing season with a minimum amount of input data on climate, soil and landscape position. Rice is cultivated under a wide variety of climatic conditions. The yield potential of rice has so far been studied under limited climatic variability. Little is known about the response of genotypes under different levels of total radiation in different temperature regimes. A project has been initiated to study rice genotype behavior in a wide range of temperature/radiation combinations under fully irrigated conditions. Emphasis has been placed on reliable radiation measurements at 22 locations world wide. (See also W90-00100) (Author's abstract)
W90-00104

USE OF RESIDENCE TIME DISTRIBUTION IN AGROCLIMATIC CLASSIFICATION.
New South Wales Univ., Kensington (Australia). Dept. of Water Engineering.
For primary bibliographic entry see Field 2B.
W90-00107

DROUGHT ASSESSMENT THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA.
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
For primary bibliographic entry see Field 2E.
W90-00109

DECISION MAKING USING A DROUGHT SEVERITY INDEX.
Australian National Univ., Canberra. Dept. of Geography.
For primary bibliographic entry see Field 6A.
W90-00110

REQUIREMENTS FOR AND USE OF A FLOOD AND AGRO-ECONOMIC DATA BASE.
Willing and Partners, Canberra (Australia).
For primary bibliographic entry see Field 7A.
W90-00111

RISK ANALYSIS OF WHEAT YIELDS IN RELATION TO CULTIVAR MATURITY AND CLIMATIC VARIABILITY IN SEMI-ARID AREAS, USING A CROP GROWTH MODEL.
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
M. Stapper, H. C. Harris, and R. C. G. Smith.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 167-184, 6 fig, 3 tab, 14 ref.

Descriptors: *Semiarid lands, *Data collections, *Water resources data, *Wheat, *Climatic data, *Agricultural hydrology, *Model studies, *Data interpretation, *Crop yield, *Risk assessment, Developing countries, Agronomy, Meteorology.

This study is part of the Environmental Zoning Project of the Farming Systems Program of the International Center for Agricultural Research in Dry Areas (ICARDA). The aim of the project is to classify the ICARDA region (Southwest Asia and North Africa) into zones to provide realistic targets for agronomic and breeding programs. It is proposed that the best way to carry out the zoning is with a crop model. A crop growth model for wheat has been developed using data from field experiments and from relevant literature. The model has initially been used to evaluate the effect of crop maturity type on wheat production in four locations in north-west Syria using 20 years of historical daily weather data. This is to examine the usefulness of the model and to determine the required quality of weather data. The analysis examined factors limiting production (soil water holding capacity or soil depth), and the effects of manipulating both crop genotype (early, medium or late maturing) and management (sowing date; sowing rate) which will minimize the effects of climatic risk. Cumulative probability functions of yield were developed from grain yield predictions and subjected to risk analysis. Optimal growing periods were determined for each of the locations. The crop growth model proved to be very useful in assessing the effects of climatic variation on crop productivity. (See also W90-00100) (Author's abstract)
W90-00114

SIMPLE MODELS FOR USE BY ADVISORY OFFICERS TO DEFINE CROP STRATEGIES AND TO PREDICT FARM YIELDS.
South Australia Dept. of Agriculture, Adelaide. Div. of Land Use and Protection.
R. J. French.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 185-194, 5 fig, 2 tab, 10 ref.

Descriptors: *Data collections, *Water resources data, *Model studies, *Crop yield, *Agriculture, *Farm management, Climatic data, Temperature, Water supply, Rainfall, Agricultural hydrology, Drought, Irrigation.

The types of crops in agricultural areas and their potential yield are related to climatic factors. The relations are complex but simple models are required by agricultural officers to advise on management strategies for farmers. An example is given of the use of day-degrees of temperature to define the developmental stages of crops and their capacity to fit within an environment in South Australia. Crop yield is strongly influenced by water supply and examples are given of how simple relations between yield and growing season rainfall can be used to indicate the deficit below the potential yield and the response to fertilizer and cultural treatments. Variability of rainfall greatly affects the stability of agricultural systems. Estimates of drought and flood frequency can be obtained from decile rainfall value. These influence the farmers attitude toward his management practices. The decile values can also be used to update yield estimates during the growing season. The simple climatic data can be used to calculate the likely yield response to irrigation. (See also W89-00100)(Author's abstract)
W90-00115

SIMULATION MODEL FOR MULTIPLE CROPS IN A RAINFED RICE-BASED CROPPING SYSTEM.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2B.
W90-00116

EVALUATION THE EFFECT OF CLIMATIC VARIABILITY ON MANAGEMENT OF DRY-LAND AGRICULTURAL SYSTEMS IN NORTH-EASTERN AUSTRALIA.
Queensland Dept. of Primary Industries, Brisbane (Australia).
G. L. Hammer, and G. M. McKeon.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 209-219, 4 fig, 1 tab, 28 ref.

Descriptors: *Data collections, *Water resources data, *Climatology, *Farm management, *Dry farming, *Agricultural hydrology, Model studies, Australia, Case studies, Sunflowers, Pastures, Cattle, Rainfall, Transpiration, Wheat.

Large variability is a feature of the climate of the major agricultural regions in northeastern Australia. This variability affects the viability and management of dryland agricultural systems in this region. Several examples of modeling and simulation studies undertaken to evaluate the impact of this climatic variability are presented. The examples include reliability of wheat cropping, management of sunflower crops, pasture options for beef enterprises and pasture establishment. Wheat cropping has been expanding westward in southern Queensland over the past decade, mainly on fine-textured soils with high water holding capacity. The structure of the crop growth model used for this study was influenced not only by the nature of the problem but also by the availability of climatic data. Water limitation is the dominating influence in this environment. Hydrologic data requirements for this study related to the need to predict the amount of soil water available for transpiration. Sunflower cropping expanded rapidly in Australia

in the early 1970's and the central Queensland region has become a major production area. This area has a highly variable rainfall and, with respect to dryland yield potential, was rated as moderate in a preliminary agroclimatic analysis based on a simple crop model. Modeling and simulation studies were undertaken to examine the management strategies of time of planting and cultivar maturity in this environment. The model developed was similar in structure to that for wheat. Models of beef production systems have been used to assess the impact of climatic variability on feed availability, diet quality, animal survival and growth. Pasture establishment is regarded as unreliable to the sub-humid area of northern Australia and simulation models have been used to examine various management practices. (See also W90-00100) (Lantz-PTT)
W90-00117

USE OF CLIMATIC DATA WITH A CROP WATER BALANCE MODEL AND CROP AND PEST RESPONSE MODELS IN NORTHERN NEW SOUTH WALES.
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
G. A. Constable, G. D. Da Roza, A. B. Hearn, and K. D. Brooks.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 221-241, 5 fig, 4 tab, 41 ref.

Descriptors: *Soil-water-plant relationships, *Data collections, *Water resources data, *Climatic data, *Agricultural hydrology, *Hydrologic models, *Pesticides, *Irrigation practices, *Model studies, Australia, Cotton, Rainfall, Temperature, Solar radiation, Nitrogen, Farm management.

This paper outlines irrigation research, irrigation scheduling and pest management of cotton. Precise irrigation scheduling is required to make most efficient use of variable natural rainfall and limited water storage. Sound integrated pest management has the aims of providing long term stability in the industry by reducing both environmental pollution and selection for resistance to pesticides. The computer based crop management system is called SIRATAC--an acronym denoting CSIRO and NSW Department of Agriculture tactics for growing cotton. Climatic data used in this system involves daily rainfall, temperature and radiation. SIRATAC pest management utilizes the concept of a yield development threshold (YDT). This is the pattern of boll setting required to achieve a target yield. The fruiting model in SIRATAC predicts, from any point in the season, whether crop development is likely to meet the growers YDT. Temperature limits the dates of start and completion of boll setting, and these dates have been calculated from long-term records for each growing area. The Ritchie water balance model has been used extensively in irrigation research projects. Irrigation experiments have defined a stress day in terms of a calculated soil water deficit. The effects of a stress day at different growth stages on subsequent yield and these important factors were used to examine a range of irrigation strategies with long-term rainfall records. For maximum profit in the long-term, it is best to allow 7 ML of irrigation water for each hectare of cotton and irrigate at 50% soil water deficit between 60 and 160 days from sowing. (See also W90-00100) (Lantz-PTT)
W90-00118

COLLECTION, QUALITY AND ACCESSIBILITY OF CLIMATIC AND HYDROLOGIC DATA USED IN AGRICULTURAL APPLICATIONS IN NEW ZEALAND.
Meteorological Service, Christchurch (New Zealand).
For primary bibliographic entry see Field 7B.
W90-00120

SALT TOLERANCE OF FIVE MUSKMELON CULTIVARS.
Haryana Agricultural Univ., Hissar (India). Dept. of Vegetable Crops.
J. L. Mangal, P. S. Hooda, and S. Lal.
Journal of Agricultural Science JASIAB, Vol. 110, No. 3, p 641-643, June 1989. 2 fig, 3 tab, 6 ref.

Descriptors: *Saline soils, *Salt tolerance, *Melon, *Crop production, Salinity, India, Plant growth.

The salt tolerance of five muskmelon (Cucumis melo L.) cultivars Hara Madhu, Punjab Sunhari, Punjab Hybrid, Pusa Madhuras and Durgapur Madhu was assessed in field plots artificially salinized with NaCl and CaCl2. Percentage germination and melon yield of all the cultivars decreased linearly with increasing soil salinity. Decline in percentage germination with increasing salinity differed with each cultivar. If soil salinity exceeded 1.11 dS/m mean germination of muskmelon decreased at a rate of 9% per unit increase in soil salinity. Similarly melon decreased at a rate of 8.73% for each unit of soil saturation salinity exceeding 1.03 dS/m. Hara Madhu had the highest rate of yield drop per unit salinity increase. The salt tolerance limit of muskmelon was found to be associated with a soil saturation salinity value of about 5.20-6.32 dS/m. (Author's Abstract)
W90-00281

WATER USE EFFICIENCY, NUTRIENT UPTAKE AND PRODUCTIVITY OF MICRO-IRRIGATED CITRUS.
New South Wales Dept. of Agriculture, Yanco (Australia). Agricultural Research Centre.
A.M. Grieve.
Australian Journal of Experimental Agriculture AAAHAN, Vol. 29, No. 1, p 111-118, 1989. 2 fig, 3 tab, 21 ref.

Descriptors: *Irrigation, *Nutrients, *Productivity, *Citrus fruits, *Irrigation efficiency, Irrigation practices, Fruit crops, Water requirements, Sprinkler irrigation, Trickle irrigation, Oranges, Nitrogen, Potassium, Phosphorus, Sodium, Chlorine.

The comparative patterns of water and nutrient uptake, soil salinity and water use efficiency resulting from two irrigation systems were studied in a 20-year-old Valencia orange orchard in Sunraysia on the Murray River. A conventional full ground cover system with the sprinklers in the middle of the rows operated at 14-day intervals, was compared with a partial (60-65%) ground cover system using under-tree micro-sprinklers operated at seven-day intervals. Irrigation applications were calculated to replace water depleted from the soil (including a leaching fraction) and were scheduled using tensiometers. Soil water extraction patterns by plant roots showed that only 5 % of water use occurred below 1.0 meters in under-tree micro-sprinkler irrigated trees, whereas 17 % of water was taken up below this depth by trees irrigated with the mid-row system. Water uptake was limited by water availability rather than root density and declined sharply in mid-row irrigated trees during the second half of the 14-day irrigation cycle. Fertilizer injection with the micro-sprinkler system significantly increased the efficiency of N and P uptake compared with surface application. Leaf K levels were lower under micro-irrigation. Fruit yield averaged 12 % (5 ton/hectare) higher from micro-irrigated trees. Tree growth was depressed in micro-irrigated trees. The net effect of micro-irrigation was to increase water use efficiency by 22%, from 3.56 to 4.34 ton fruit per ML applied water. (Author's abstract)
W90-00290

RUBBER HEAT ENGINE FOR GROUND WATER IRRIGATION IN INDIA.
R. Singh.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 4, p 271-278, April 1989. 1 fig, 3 tab, 7 ref.

Descriptors: *India, *Pumps, *Energy sources, *Pumps, *Groundwater irrigation, Irrigation, Rubber heat engine, Irrigation wells.

The rubber heat engine can provide a cheap solution to the pumping of ground water for additional dry-season farm production in developing countries. Rubber heat engines are typically high torque-low revolutions per minute devices which derive their power from the small temperature differences that exist between hot dry air or solar-heated water and the cooler well water that is to be pumped. A 400 mm diameter engine containing 100 g of 1120-denier polyurethane fibers produced 20 W at 80 revolutions per minute when the change in temperature is 60 C. The net power produced can be tripled by doubling the rubber loading, using finer fibers and using better crankshaft bearings. (Mertz-PTT)
W90-00291

NITRATE CONCENTRATIONS IN PERCOLATE AND GROUNDWATER UNDER CONVENTIONAL AND NO-TILL ZEA MAYS WATERSHEDS.
Maryland Univ., College Park. Dept. of Agronomy.
J. A. Angle, and M. S. McIntosh.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 4, p 279-286. 3 fig, 21 ref.

Descriptors: *Path of pollutants, *Agricultural hydrology, *Leaching, *Percolation, *Nitrates, *Fertilizers, *Cultivation, *Groundwater pollution, *No-till cultivation, Corn, Agricultural watershed, Conventional cultivation.

A three-year study was conducted to determine whether differences existed in NO3-N concentrations under soils planted to conventional and no-till corn (Zea mays L.). Defined watersheds were instrumented with wells and suction lysimeters. Wells and lysimeters were also placed on the uphill side of the watersheds in a grassed control area. Groundwater and percolate were collected monthly and analyzed for NO3-N. The NO3-N in percolate collected from the grassed control was uniformly low, averaging 2 mg per liter. Few significant differences were detected between the two tillage systems, except in 1987. During the first five months of 1987, the percolate NO3-N concentration collected from a depth of 1.5 m was 15 and 50 mg per liter, for the no-till and conventional-till watersheds, respectively. The groundwater NO3-N concentration was consistently lower than the concentration in the percolate. The groundwater NO3-N concentration under the grassed control was generally low, averaging 2 mg per liter. For most of the months examined, the NO3-N concentration in groundwater from the watersheds was significantly greater than from the control area. The average groundwater NO3-N concentration of the two watersheds over the entire study was approximately 9 mg per liter. No significant difference was detected between the two watersheds except for 1984. In 1984, the groundwater NO3-N concentration from the conventional-till watershed was significantly greater than from the no-till watershed. These results indicate that the concentration of NO3-N under no-till cultivation is equal to or less than the NO3-N concentration under conventional-till cultivation. (Author's abstract)
W90-00292

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. I. ROOT AND SHOOT GROWTH.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
R. C. Nageswara Rao, L. P. Simmonds, S. N. Azam-Ali, and J. H. Williams.
Experimental Agriculture EXAGAL, Vol. 25, No. 1, p 51-61, January 1989. 5 fig, 1 tab, 24 ref, append.

Descriptors: *Peanuts, *Plant populations, *Soil-water-plant relationships, *Plant growth, *Root development, India, Crop yield, Shoots.

The growth of roots and shoots was measured in stands of groundnut grown at a number of populations on stored water in central India. Total weight and length of roots per unit land area increased with population density, but the proportional increases were much less than for shoot weight. Consequently, the root:total weight ratio increased

from 0.3 in the densest stand to almost 0.5 in the widely spaced crop. The denser stands produced a greater proportion of their roots at depth. In wide rows there was little change in rooting density across the inter-row space. Total dry matter per unit land area increased with population, although the weight per plant was less in denser stands. Although the crops were harvested prematurely, pod yield per unit land area, unlike total dry matter, was no greater in dense stands than in more widely spaced crops. The greatest number of pods per unit land area was recorded at an intermediate population density. (See W90-00318 thru W90-00320) (Author's abstract)
W90-00317

POPULATION, WATER USE AND GROWTH OF GROUNDNUT MAINTAINED ON STORED WATER. II. TRANSPIRATION AND EVAPORATION FROM SOIL.
Nottingham Univ. (England). School of Agriculture.
L. P. Simmonds, and J. H. Williams.
Experimental Agriculture EXAGAL, Vol. 25, No. 1, p 63-75, January 1989. 9 fig, 4 tab, 20 ref.

Descriptors: *Peanuts, *Plant populations, *Soil water, *Soil-water-plant relationships, *Plant growth, *Transpiration, *Evaporation, Soil moisture deficiency, India, Water storage.

Stands of groundnut were grown at four densities on water stored in a medium depth alfisol in central India. Evaporation was estimated from changes in soil water content, and partitioned between transpiration and evaporation from the soil surface. Seasonal transpiration was strongly influenced by plant population, and approached a maximum as the population density increased to 23 plants/sq m. Evaporation from the soil surface was only a small component of the seasonal water balance in dense stands, and was little affected by planting density. Differences in transpiration rate between spacings were greatest early in the season, but diminished when the denser stands ran out of water. The denser stands extracted more water from deep in the profile. Plants in widely spaced rows preferentially extracted water from near the row; water mid-row was only used later in the season. (See also W90-00317, W90-00319, and W90-00320) (Author's abstract)
W90-00318

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. III. DRY MATTER, WATER USE AND LIGHT INTERCEPTION.
Nottingham Univ. (England). School of Agriculture.
S. N. Azam-Ali, L. P. Simmonds, R. C. Nageswara Rao, and J. H. Williams.
Experimental Agriculture EXAGAL, Vol. 25, No. 1, p 77-86, January 1989. 5 fig, 2 tab, 16 ref.

Descriptors: *Peanuts, *Plant populations, *Soil water, *Plant growth, *Dry matter, *Soil-water-plant relationships, *Transpiration, *Solar radiation, India, Water use, Interception.

At a field site in central India, four populations of groundnut (Arachis hypogaea L.) were grown on stored water to investigate how the production of shoot and root dry matter is related to transpired water and intercepted radiation. Throughout the season, total dry matter was closely related to transpiration (slope=3.0 mg dry matter/g water) and the amount of radiation intercepted by foliage (slope=0.74 g dry matter/MJ radiation intercepted). Accumulated transpiration increased linearly with intercepted radiation at 0.37 ky water/MJ in the sparser stands. In the densest spacing, the initial slope of the relation at 0.28 kg/MJ decreased later in the season because water deficits curtailed growth without a concomitant reduction in the interception of radiation. (See also W90-00317, W90-00318, and W90-00320) (Author's abstract)
W90-00319

POPULATION, GROWTH AND WATER USE OF GROUNDNUT MAINTAINED ON STORED WATER. IV. THE INFLUENCE OF POPULATION ON WATER SUPPLY AND DEMAND.
Nottingham Univ. (England). School of Agriculture.
L. P. Simmonds, and S. N. Azam-Ali.
Experimental Agriculture EXAGAL, Vol. 25, No. 1, p 87-98, January 1989. 6 fig, 1 tab, 10 ref.

Descriptors: *Peanuts, *Plant populations, *Water supply, *Water demand, *Soil water, *Transpiration, *Plant growth, Solar radiation, Soil moisture deficiency, Soil-water-plant relationships, India.

The objective of this paper was to identify the major factors responsible for the differences in transpiration rate between stands of groundnut grown at three row spacings on stored water in central India. A method of analysis was developed to distinguish between the impact on transpiration of ground cover (which varied threefold between spacings) and of root:shoot ratio, which was substantially greater in the wider row spacings. When the soil was wet, both transpiration and the canopy conductance, were approximately proportional to the fraction of incident radiation intercepted by foliage. But when the soil water content decreased below a threshold value, transpiration rate/fraction of incident radiation intercepted and canopy conductance/ fraction of incident radiation intercepted decreased because of an increase in stomatal resistance. Stomatal closure in response to soil water stress occurred sooner in the denser stands, partly because of more rapid depletion of soil water. A second contributory factor was that the sparser stands (which had a relatively large root:shoot ratio) had a greater capacity to keep stomata open as the soil water deficit increased. (See W90-00317 thru W90-00319) (Author's abstract)
W90-00320

WELLTON-MOHAWK FARMERS DELIVER WATER CONSERVATION.
Soil Conservation Service, Portland, OR. West National Technical Center.
J. D. Hedlund.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 6, p 462-464, November-December 1988. 1 ref.

Descriptors: *Irrigation programs, *Irrigation effects, *Water conservation, Environmental effects, Water management, Arizona.

In 1973 an interagency committee was established to identify the potential for improving irrigation efficiency in an effort to reduce return flow in Arizona's Wellton-Mohawk Irrigation and Drainage District. A program was needed to reduce saline pollution in the Colorado River. The program implemented provided 75 % federal cost-share money for installation of on-farm improvements. The new irrigation systems saved farmers water, fertilizer, and labor and increased yields made irrigating easier. Through water management tactics such as upgrading level basin systems, installing accurate measuring devices and adopting good water conservation systems, the farmers reduced diversions to the valley by 20 % and irrigation return flow by half. In addition, the Bureau of Reclamation is currently building the world's largest reverse osmosis desalting plant to treat smaller volumes of drainage flow now going into the Gulf of California. (Mertz-PTT)
W90-00325

POTENTIAL DEMAND FOR SUPPLEMENTAL IRRIGATION IN THE LOWER MISSISSIPPI VALLEY.
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness.
S. A. Henning.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 1, p 75-79, January-February 1989. 4 tab, 10 ref.

Descriptors: *Water demand, *Irrigation requirements, *Irrigation programs, *Louisiana, *Water potentials, *Irrigation, Mathematical models, Water requirements, Soil profiles, Cost analysis, Mississippi Valley.

A multiperiod, mathematical linear programming model was used to project demand for supplemental irrigation in one production area of the Lower Mississippi Valley. The study area included three parishes in northeastern Louisiana. Projections of demand for supplemental irrigation were made at 5-year intervals, with 1985 as the base year, through the year 2000. The programming model combined information on crop water requirements and yield potentials of soil mapping units with corresponding crop budgets and irrigation costs to estimate optimal combinations of irrigated and nonirrigated crops. The objective function of the programming model was to maximize net return for each parish. Results indicated significant economic potential for expanding supplemental irrigation in the region. Once the area of potential expansion had been identified, the model was used to evaluate alternative scenarios for agricultural water use due to changes in the allocation process, conservation of soil and/or water, and water quality. (Author's abstract)
W90-00332

GEOLOGY AND SURVIVAL ON THE SNAKE RIVER PLAIN.
For primary bibliographic entry see Field 5G.
W90-00335

SOIL RESISTANCE TO EROSION IN THE SOUTHERN UKRAINE AND CHANGE THEREIN DUE TO IRRIGATION.
Odesskii Gosudarstvennyi Univ. (USSR).
For primary bibliographic entry see Field 2J.
W90-00338

MINERAL COMPOSITION OF A TYPICAL CHERNOZEM WITH REGULAR FERTILIZATION AND IRRIGATION.
B. S. Nosko, and I. I. Filon.
Soviet Soil Science SSSCAE, Vol. 20, No. 4, p 99-105, July-August 1988. 3 tab, 17 ref.

Descriptors: *Fertilization, *Soil analysis, *Soil classification, *Soil physical properties, *Irrigation effects, *USSR, *Minerals, Chernozem soils, Hydromica, Kaolinite, Vermiculite, Smectite, Quartz, Clay loam.

Sandy loam clay-silt, and Typical Chernozem on the Grakov experimental field in Chuguyevskiy Rayon, Khar'kov Oblast were studied. The research was done strictly on documented background fertilization plots of a long-term field experiment that was begun in 1966, using the following treatments with and without irrigation: (1) control (no fertilizer) (2) N(aa)P(cr)K(x); (3) manure. Soil samples were collected from three replications of the field experiment at depths of 0-30 and 40-50 cm. During the period of the study, an average of 90 kg of nitrogen, 60 kg of phosphorus, 60 kg of potassium, and 14 metric tons of manure were applied annually to each hectare. Corn for green fodder, winter wheat, sugar beets, and corn cut for silage were rotated in the experimental plots. Mineralogy and lithology of the particle-size fractions of the Typical Chernozem were studied by the immersion optical method. Mineral composition of the clay fraction was determined by X-ray diffractometry. It was concluded that light minerals, i.e., clays and feldspars, predominate in the soil, while the principal heavy minerals are epidote, ilmenite and hornblende. Long-term fertilization and irrigation had no significant effect on the concentrations of light and heavy minerals in the various fractions of a Typical Chernozem, but it promoted dispersion of unstable, partly ordered mixed-layer minerals of the hydromica-smectite type. (Mertz-PTT)
W90-00339

EFFECT OF IRRIGATION RATE ON SOLUTE TRANSPORT IN SOIL DURING STEADY WATER FLOW.
Oxford Univ. (England). Soil Science Lab.
J. S. Dyson, and R. E. White.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 19-29, March 30 1989. 2 fig, 18 ref.

Descriptors: *Path of pollutants, *Fertilizers, *Solute transport, *Irrigation effects, *Soil water, *Leaching, *Aeration zone, *Soil types, Soil porosity, Soil physical properties.

Solute transport is not directly dependent on irrigation rate in some soils (Class I); in other soils (Class II) it is. In Class I soils, solute transport is effectively dependent on the net movement of water only, rather than its rate. A soil may be in Class I if its water content and the fractional solute transport volume, based on the mean and median resident times in the soil, remain approximately constant with changes in irrigation rate. The prediction of solute transport in Class I soils is more efficient because less data is required: measurements made at one irrigation rate apply at many others. However, little has been published on which class different types of soil fall into. A structured clay soil (Evesham series), which exhibited a pronounced asymmetric leaching pattern, had Class I characteristics for irrigations between 0.3 and 3.0 cm/h under steady flow conditions. This result was encouraging because such a leaching pattern is often ascribed to flow in macropores, which is supposedly highly dependent on irrigation rate. Many other soils may have Class I characteristics, especially as most soils contain some macropores. There was, however, a small trend of median resident time with irrigation rate in the Evesham soil. This trend suggests that the range of values of irrigation rate likely to be encountered should play a central role in testing whether a soil is Class I or II. Further studies are required for transient flow conditions for rainfall onto initially dry soils, in which irrigation rate and initial water content are both known to affect strongly the way in which solutes move through the soil. (Author's abstract)
W90-00352

EVALUATING THE PERFORMANCE OF TANK IRRIGATION SYSTEMS.
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agricultural Economics.
K. Palanisami, and J. C. Flinn.
Agricultural Systems AGSYD5, Vol. 28, No. 3, p 161-177, 1988. 2 fig, 5 tab, 14 ref.

Descriptors: *Irrigation, *Tank irrigation, *Water tanks, *Computer models, Performance evaluation, Rice, Crop yield, Simulation, Economic evaluation, India.

A simulation model was developed for a major tank irrigation system in Tamil Nadu, India. This model was used to evaluate the performance of tank irrigation under existing and alternative physical improvements (sluice modification, canal lining and provision of additional wells) and management strategies (e.g. sluice and rotation management). The model operated on a daily basis using data relating to weather, tank hydrology and farmer-related inputs of a typical rice-irrigation tank. The model computed stress days, rice yield reduction, and income distribution in head and tail locations of the system. The benefits of tank improvements were based on the behavior of the tank system using a 10-year tank irrigation cycle. Three evaluation criteria, viz., productivity ratio, equity ratio and financial measures, were used to evaluate the investment strategies. Productivity and equity ratios were not in conflict when the objective was to improve productivity and income of the system. Financial analysis showed that canal lining, providing additional wells, and sluice management when used individually and in combination, improved the overall performance of the tank system. (Author's abstract)
W90-00400

ENERGY PARAMETERS FOR RAISING CROPS UNDER VARIOUS IRRIGATION TREATMENTS IN INDIAN AGRICULTURE.
Punjab Agricultural Univ., Ludhiana (India). Coll. of Agricultural Engineering.
J. P. Mittal, and K. C. Dhawan.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 1, p 11-25, January 1989. 5 tab, 8 ref.

Descriptors: *Irrigation, *Agriculture, *Crop production, *Fuel, *Energy, *India, Farming, Energy requirements.

The energy requirements for raising crops in different ecological zones of India are estimated. In the production of a crop, irrigation, seed-bed preparation, harvesting and threshing were found to be energy-intensive operations. Further, it was found that irrigation consumed up to 60% of the total energy requirements for crop production under different methods of irrigation. Sugarcane, cotton, paddy and wheat crops required the greatest amounts of energy per unit area whereas maize consumed the least. Human energy use was from 4 to 20%. Fossil energy is used to a great extent by almost all the crops. It was concluded that the specific energy requirements for the production of crops did not differ significantly with irrigation methods. Therefore, it is recommended that any of the irrigation methods may be adopted in raising a crop in a particular area according to the convenience and expertise of the farmers of the locality. (Author's abstract)
W90-00429

NUTRIENT INPUT AND OUTPUT OF AN IRRIGATED AGROECOSYSTEM IN AN ARID MEDITERRANEAN LANDSCAPE.
Mediterranean Agronomic Inst. of Zaragoza (Spain).
J. Bellot, and F. B. Golley.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 2-3, p 175-186, March 1989. 3 fig, 7 tab, 17 ref.

Descriptors: *Irrigation, *Cycling nutrients, *Nutrients, *Mediterranean, *Arid climates, *Agronomy, Spain, Input, Output.

The annual chemical input and output dynamics of a 5000-ha irrigated landscape in northern Spain are examined. Water input from irrigation and from precipitation averages 1573 mm annually. Output of water through the drainage canal is 900 mm annually. Evapotranspiration loss is 674 mm. Chemical inputs to this agroecosystem are in water and fertilizer. Inputs of Cl, S, Ca, Mg, and Na are largely from irrigation water. Inputs of N, P and K are largely from fertilizer. Total dissolved ion loss in this drainage water is about 10.7 MT/ha/year, and is largely calcium and sulfate. Output of N and P was greatest in harvested product. output of the other elements was greatest in drainage water. There is an excess of input over output for N, P and K, and for the system as a whole, an excess of output over input for Cl, S, Ca, Mg and Na. Comparison of this pattern with forested watersheds indicates that this irrigated system is operating on a water budget which is like that of a humid, temperate region. This water subsidy results in turnover of the chemical elements many times greater than the rates on forested systems. (Author's abstract)
W90-00432

LEACHING OF SALTS FROM SALINE HEAVY CLAY SOILS: FACTORS AFFECTING THE LEACHING PROCESS.
Southampton Univ. (England). Inst. of Irrigation Studies.
T. W. Tanton, D. W. Rycroft, and F. M. Wilkinson.
Soil Use and Management SUMAEU, Vol. 4, No. 4, p 133-139, December 1988. 7 fig, 9 ref.

Descriptors: *Soil management, *Soil reclamation, *Leaching, *Salts, *Montmorillonite, Irrigation efficiency, Clays, Infiltration, Hydraulic conductivity, Soil water, Permeability, Soil properties.

If saline clay soils are to be reclaimed for agricultural purposes, the build up of salt deposits must be avoided by allowing natural leaching processes to occur. Once cracks in dry saline montmorillonitic clays are closed, the only effective pathways remaining for the movement of leaching water are old root channels and faunal burrows. The role of artificial restructuring of the soil as a means of improving the macropore structure was investigated in laboratory cylinders using montmorillonite clay. The leaching of restructured saline clays was also studied in similar columns, but with clay fully salinized by immersion in water with an EC of 8.4 dS/m for one month. All soils remained fairly stable when their moisture content exceeded about 24%, while non-saline, clay soil remained stable until the moisture content became less than 16%. Restructuring of clay introduced sufficient permeability to a depth of about 0.7 to 0.8 m provided the clay did not become unsaturated upon leaching. (Geiger-PTT)
W90-00509

LEACHING OF SALTS FROM RESTRUCTURED SALINE CLAY SOILS.
Southampton Univ. (England). Inst. of Irrigation Studies.
T. W. Tanton, A. S. B. Armstrong, and D. W. Rycroft.
Soil Use and Management SUMAEU, Vol. 4, No. 4, p 139-143, 6 fig, 1 tab, 2 ref.

Descriptors: *Soil reclamation, *Soil management, *Leaching, *Salts, *Montmorillonite, Clays, Irrigation efficiency, Hydraulic conductivity, Drainage, Infiltration, Soil properties.

The leaching of salt from a restructured saline heavy montmorillonite clay soil was studied experimentally at the Seyhan Irrigation Project near Tarsus in southern Turkey. Restructured clay was placed in a 25-m long by 0.75-m deep polythene-lined trench and leaching studied under flood irrigation. The hydraulic conductivity of the soil always exceeded 25 m/day during the experiment, and 85% of the salt was leached within 16 days, most being leached in the first 8 days. The advancing soil water profiles on first wetting indicated that the entire soil profile was rapidly immersed so that leaching could be expected to take place through the entire soil profile fairly soon after first irrigation. The results suggested that restructuring clay could make the drainage of heavy clay soils economically feasible. (Geiger-PTT)
W90-00510

EFFECT OF DRAINAGE WATER ON NODULATION, NITROGEN FIXATION AND GROWTH OF FABA BEAN.
King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 2I.
W90-00535

GUIDELINES FOR SELENIUM IN IRRIGATION WATERS.
California Univ., Riverside.
For primary bibliographic entry see Field 5G.
W90-00563

GUIDELINES FOR MOLYBDENUM IN IRRIGATION WATERS.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 5G.
W90-00564

DETECTION OF MOISTURE STRESS BY INDICATOR PLOTS--A SIMULATION.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W90-00574

EFFECTS OF THREE IRRIGATION REGIMES ON GROWTH PARAMETERS AND YIELD OF DRIP IRRIGATED SWEET CORN (ZEA MAYS CV. SURESWEET) (TRES NIVELES DE RIEGO, CRECIMIENTO Y RENDIMIENTO DE MAIZ DULCE (ZEA MAYS CV. SURESWEET) REGADO POR GOTEO).
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
E. A. Gonzalez-Fuentes, M. R. Goyal, and C. Chao de Baez.
Journal of Agriculture of the University of Puerto

Rico, Vol. 72, No. 4, p 565-574, October 1988. 5 fig, 2 tab, 19 ref. English summary.

Descriptors: *Irrigation, *Agriculture, *Drip irrigation, *Corn, *Crop yield, Puerto Rico.

The objective of this study was to evaluate the effects of 3 irrigation regimes on the growth characteristics and commercial yield of drip-irrigated sweet corn. A field experiment was established in the winter of 1985-86 at the Fortuna substation, Juana Diaz, on the semiarid south coast of Puerto Rico. A randomized complete block design with three irrigation levels (wet=T1, moist=T2, dry=T3) based upon tensiometers at 15-, 30-, and 45-cm soil depth, respectively was used. Treatments were replicated 4 times. A low pressure biwall drip irrigation system was used. Commercial sweet corn was 6487, 5034 and 3879 kg/ha in the T1, T2, and T3 plots, respectively. The wet treatment (T1) yielded significantly more than T2 and T3 at P=0.05. Increases were 28.9 and 67.3% compared with T2 and T3, respectively. T3 caused a reduction of 41% in the number of ears per hectare. The average weight and length of ears were not significantly different at P=0.05. Weekly fresh and dry plant weight, fresh and dry total weight, plant height, length of ear vs. days after planting relationships were of sigmoidal type. Coefficient of correlation and regression coefficients were significant at P=0.05. (Author's abstract) W90-00586

NUTRIENT UPTAKE AND GROWTH CHARACTERISTICS OF NITROGEN FERTIGATED SWEET PEPPERS UNDER DRIP IRRIGATION AND PLASTIC MULCH.

Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.

M. Crespo-Ruiz, M. R. Goyal, C. Chao de Baez, and L. E. Rivera.

Journal of Agriculture of the University of Puerto Rico, Vol. 72, No. 4, p 575-584, October 1988. 4 fig, 2 tab, 7 ref.

Descriptors: *Agriculture, *Drip irrigation, *Mulching, *Sweet pepper, *Nutrients, *Fertilization, *Crop yield, Nitrogen, Phosphorus, Potassium, Puerto Rico.

In the semiarid southern coast of Puerto Rico at the Fortuna agricultural experiment substation, Juana Diaz, a study was conducted on N, P, and K uptake by N-fertigated sweet peppers (cv. Cubanelle) and growth parameters (fresh and dry weight of plant, fresh and dry weight of fruit). The treatments were T1=500, T2=300 and T3=150 kg of N/ha in 11 applications via drip irrigation, T4=500 kg of N/ha banded, T5=control, replicated 4 times in a complete randomized split plot design. The N source was urea. The subplots were used for plastic mulched and nonmulched plots. The relationships between N, P, K and growth parameters vs. days after transplanting were determined by the equation Y=A/(B+(C-X)squared, a Mitscherlich-type curve, where Y=growth parameter (g/plant), X=days after transplanting, and A,B,C=regression coefficients. These relationships indicated 5 phases of nutrient uptake. The coefficient of determination varied from 0.55-0.85 for growth parameters and from 0.70-0.99 for nutrient uptake. Nutrient uptake values were significantly higher in the last third of the growing cycle. The commercial pepper yield was 46.8, 51.2, 43.1 31.0 and 20.8 tons/ha with plastic mulching compared to 26.2, 34.6, 27.9, 25.9, and 14.8 tons/ha with no mulching in the T1, T2, T3, T4 and T5 plots, respectively. Fertigation with 300 kg/ha of N produced a higher commercial yield compared with fertigation and control at P=0.05. Plastic mulching increased pepper yield significantly over that with no mulching at P=0.05. (Author's abstract) W90-00587

IRRIGATION REQUIREMENTS OF SORGHUM IN SOUTH AND NORTH COASTS OF PUERTO RICO (REQUISITOS DE RIEGO PARA SORGA EN LAS COSTAS SUR Y NORTE DE PUERTO RICO).

Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.

M. R. Goyal, and E. A. Gonzalez.

Journal of Agriculture of the University of Puerto Rico, Vol. 72, No. 4, p585-598, October 1988. 11 tab, 11 ref. English summary.

Descriptors: *Agriculture, *Irrigation, *Irrigation requirements, *Sorghum, Temperature, Rainfall, Puerto Rico.

Net irrigation requirements (NIR) of sorghum were estimated for 3 crop durations (3, 3.5 and 4 months) and 5 planting dates at the Fortuna Agricultural Experiment Substation, Juana Diaz, in the south coast, and the Isabela Agricultural Experiment Substation, in the north coast, of Puerto Rico. A modified Blaney -Criddle model was used to estimate monthly consumptive use (CU) with the temperature and rainfall data for these two locations. CU and NIR were highest at Fortuna than at Isabela for all 3 crop durations. For the January planting, the monthly NIR range (in) was 2.57-3.83 for 90 days, 0.71-3.83 for 3.5 months, and 2.13-4.24 for 120 days at Fortuna, and 1.53-2.76 for 3 months, 0.00-2.76 for 105 days, and 1.18-3.03 for 4 months at Isabella. Seasonal NIR (in) was 9.36 for 3 months, 11.13 for 3.5 months, and 12.79 for 120 days at Fortuna compared with 6.95 for 3 months, 7.40 for 105 days, and 8.80 for 4 months at Isabela. At both locations minimum NIR ws observed in March for 3 months and in April for 3.5 and 4 months. For ali planting dates, seasonal NIR (in) ranged between 8.46 -9.36, 10.37-11.13, and 11.67-12.79 for 3, 3.5 and 4 months at Fortuna compared with 5.34-6.45, 6.36-7.40 and 7.51-8.80 for 3, 3.5 and 4 months at Isabela. In both locations minimum total NIR was observed in the January planting. NIR was also estimated for a 20% rainfall probability which would represent dry years. (Author's abstract)
W90-00588

IRRIGATION REQUIREMENTS FOR PLANTAINS IN SEVEN ECOLOGICAL REGIONS OF PUERTO RICO (REQUISITOS DE RIEGA PARA PLATANO EN SIETE REGIONES ECOLOGICAS DE PUERTO RICO).

Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.

M. R. Goyal, and E. A. Gonzalez.

Journal of Agriculture of the University of Puerto Rico, Vol. 72, No. 4, p 599-614, October 1988. 3 tab, 10 ref. English summary.

Descriptors: *Agriculture, *Irrigation, *Irrigation requirements, *Sorghum, Temperature, Rainfall, Puerto Rico.

Consumptive use (CU, cm), net irrigation requirements (NIR, cm) and gross irrigation (GIR, cm) of plantains were estimated for 7 climatic regions of Puerto Rico. A modified Blaney-Criddle model was used to estimate CU with the temperature and rainfall data of the Adjuntas, Corozal, Fortuna, Gurabo, Isabela, Lojas and Mayaguez agricultural experiment substations, Puerto Rico. CU was estimated for January planting and for 50% moisture depletion. For all locations minimum and maximum CU was observed in February and September. During the year, CU ranged from 5.56-12.52 cm for Adjuntas, 6.80-15.06 for Corozal, 7.54-16.41 for Fortuna, 7.24-15.82 for Gurabo, 7.01-15.29 for Isabela, 7.04-15.47 for Lojas, and 7.26-15.52 for Mayaguez. The daily CU range was 3.2-4.2 mm/day corresponding minimum at Adjuntas and maximum at Fortuna. The daily CU (mm) was 3.9 for Corozal, 4.1 for Gurabo, 3.9 for Isabela, and 4.0 for Lojas and Mayaguez. For all locations the NIR range (cm) was 2.64-5.61 at Adjuntas, 3.48-10.21 at Corozal, 6.53-10.52 at Fortuna, 4.62-9.22 at Gurabo, 4.17-9.18 at Isabela, 5.77-11.84 at Lojas, and 5.79-9.17 at Mayaguez. Surface irrigation (efficiency 40%) duplicated water requirement (GIR) compared to drip irrigation (efficiency 80%). With the surface irrigation, annual GIR was 123.13 for Adjuntas, 197.48 for Corozal, 298.13 for Fortuna, 225.23 for Gurabo, 215.58 for Isabela, 263.25 for Lojas, and 205.93 for Mayaguez. Nir was also estimated for 20% rainfall probability which would represent dry years. (Author's abstract)
W90-00589

SEASONAL CONSUMPTIVE USE OF WATER BY BELL AND CUBANELLE PEPPERS IN SEMIARID AND HUMID COASTAL SITES IN PUERTO RICO.

Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.

For primary bibliographic entry see Field 2I.
W90-00590

INFLUENCE OF SIMULTANEOUS CHANGES IN SODICITY AND PH ON THE HYDRAULIC CONDUCTIVITY OF AN ALKALI SOIL UNDER RICE CULTURE.

Central Soil Salinity Research Inst., Karnal (India).

R. K. Gupta, R. R. Singh, and I. P. Abrol.

Soil Science SOSCAK, Vol. 147, No. 1, p 28-33, January 1989. 5 fig, 2 tab, 20 ref.

Descriptors: *Irrigation effects, *Rice, *Alkaline soils, *Hydraulic conductivity, *Soil chemistry, Soil water, Carbon dioxide, Hydrogen ion concentration, Calcium carbonate, Soil columns, Manure, Roots, Calcareous soils, Soil tests, Soil management.

It is suggested that any factor favoring a buildup of high carbon dioxide partial pressure (PCO2) will favor dissolution of calcium carbonate in soils and aid in the reclamation of alkali soils by providing a source of soluble calcium required for the replacement of exchangeable sodium. Rice culture is recommended for adoption during the reclamation of alkali soils owing to its high tolerance of soil sodicity. A laboratory study was performed to evaluate the chemical significance of PCO2 buildup, by reduction in soil pH and sodicity on the associated increase in hydraulic conductivity (HC) for rice culture conditions. Soil HC was determined at constant hydraulic head in soil columns packed to a bulk density of 1.47 grams per cubic centimeter and flushed with CO2 to obviate air entrapment in the presence and in the absence of farmyard manure (FYM) and rice. Hydraulic conductivity of alkali soils generally was least improved by continuous submergence, but was more improved in FYM-treated soils. Growing rice further increased the HC of soils. Exchangeable sodium removal and reductions in pH appear to be directly related to the amount of CO2 production in calcareous strongly alkali soils. It seems that the physical presence of an active root system yields a certain HC, but chemical reclamation is primarily through more CO2 production. Organic manures improve rice growth because they raise PCO2 to reduce pH and sodicity through greater mobilization of soil lime. (Author's abstract)
W90-00638

SHORT TERM EFFECTS OF NUTRIENT ENRICHMENT ON THE QUALITY OF IRRIGATION WATER.

Nessin Water Quality Central Lab., Nazareth (Israel).

For primary bibliographic entry see Field 5C.
W90-00828

GROUNDWATER TABLE SIMULATION UNDER DIFFERENT RICE IRRIGATION PRACTICES.

Institute of Flood Control and Drainage Research, Dacca (Bangladesh).

A. F. M. Saleh, T. S. Steenhuis, and M. F. Walker.

Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 530-544, August 1989. 5 fig, 2 tab, 23 ref, append.

Descriptors: *Groundwater irrigation, *Rice, *Groundwater mining, *Irrigation effects, Simulation analysis, Model testing, Seasonal depletion, Hydrologic cycle, Precipitation, Percolation, Vadose water, Groundwater recharge, Evapotranspiration, Base flow, Bangladesh, Groundwater management, Agricultural engineering.

Most rice culture in southern Asia occurs on relatively flat soils with seasonally high groundwater tables. Groundwater is often available for use during the dry season for irrigation. Bangladesh is a southern Asian country where dry season rice

irrigation is rapidly increasing, causing concern for possible groundwater depletion. A simulation model has been developed to analyze the impacts that different irrigation management schemes have on groundwater levels. The model includes all aspects of the hydrological cycle, such as precipitation, irrigation, evapotranspiration, percolation, recharge, and river base flow. It consists of two linked models--one for the vadose and one for the groundwater zones. This model was checked for realism in northwest Bangladesh where four irrigation management schemes were tested for their groundwater mining potential. This analysis showed that, while the practice of irrigation caused the level of the groundwater table to drop several meters, the various schemes for managing the rice irrigation had little influence on the groundwater level. When irrigation is used, groundwater levels require 30-60 days longer each year to recover as compared to no irrigation. The length of the recovery period is related more to rainfall than to variations in irrigation management schemes. The probability of the aquifer not fully recharging in any single year as a result of irrigating from the groundwater is less than 10% for the location simulated for Bangladesh. The risk of a trend of groundwater mining over a several year period is extremely low. (Fish-PTT)
W90-00879

IMPROVED APPROACH TO IRRIGATION SCHEDULING PROGRAMS.
Orange Software, Fresno, CA.
S. Pleban, and I. Israeli.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 577-587, August 1989. 3 tab, 13 ref, append.

Descriptors: *Irrigation efficiency, *Irrigation programs, *Agricultural engineering, *Scheduling, *Farm management, Optimum development plans, Computer programs, Management planning, Crop production.

Several available irrigation scheduling computer programs use the water balance method. The acceptance of these irrigation scheduling programs among farmers has been slow. A possible reason for the slow acceptance of these programs is that they are research oriented and do not look at the scheduling problem from the farmer's point of view. An improved approach to writing irrigation scheduling programs using the water balance method is suggested. It is based on defining the irrigation scheduling problem from the farmer's viewpoint and adapts the model interface to his concepts and needs. The program adds to the traditional approach of 'management depletion,' scheduling by interval, scheduling by irrigation amount (irrigation depth, duration. and volume), and scheduling by crop indicators. (Author's abstract)
W90-00883

GRAVITY IRRIGATION MANAGEMENT IN BANGLADESH.
Agric. Engrg. Div., Bangladesh Rice Res. Inst. (BRRI), G.P.O. Box No. 911, Dhaka, Bangladesh.
M. A. Ghani, S. I. Bhuiyan, and R. W. Hill.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 642-655, August 1989. 2 fig, 7 tab, 20 ref, append.

Descriptors: *Irrigation efficiency, *Irrigation programs, *Water shortage, *Water management, *Agricultural engineering, Water delivery, Rice, Crop yield, Pumping, Scheduling, Rotational flow, Water allocation, Water distribution, Farming, Operating costs, Bangladesh.

The management of rotational irrigation water distribution as practiced in Bangladesh could be improved. A study performed in the Ganges-Kobadak irrigation project included fields in nine tertiary areas along three secondary canals. Irrigation water shortages were experienced in most parts of the system during 1983-1985 and will continue until irrigation water delivery amounts are significantly increased. Average rice yields in the March-August and July-December seasons are above the national average. However, yield increases could be realized with adoption of improved water management practices. A reliable pump operation schedule, which will not change from year to year, must be developed immediately and implemented. The start-up and shut-down schedule should be known to all farmers so that they can confidently plan their cropping activities. A nine-day rotational schedule is a technically sound and socially desirable method of water allocation-distribution for the project. A larger number of farmers within the project command area benefit than if water deliveries were continuous, as per the original design of the project. Priority areas which can be served with irrigation water should be identified and programmed in advance. Pump operation should be suspended during the rainfall period to reduce operational costs. (Fish-PTT)
W90-00887

FUTURE IRRIGATION PROSPECTS AND ACTIONS IN DEVELOPING COUNTRIES.
International Bank for Reconstruction and Development, Washington, DC. Agriculture Production and Services Div.
G. J. M. Le Moigne, H. D. Frederiksen, and W. J. Ochs.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 656-661, August 1989. 1 tab.

Descriptors: *Irrigation programs, *Agricultural engineering, *Developing countries, *Economic development, *Government supports, Water quality management, Population dynamics, Government finance, Economic aspects, Government interrelations, Legislation, Policy making, Technology transfer, Resources development, Resources management, Water supply development.

Irrigation has evolved as a major factor in commercial agriculture. However, the recent overproduction in the sector, combined with a restricted worldwide economy, has caused concern for users of many irrigation activities. Nevertheless, the pressures from the ongoing population growth, and many other aggravating factors, will again place increased demands on food production. Government policies and programs, the thrust of development aid, and the role of the nongovernmental sector will have to change to meet these future needs. In most countries, irrigated agriculture will have to be viewed and treated more akin to other industries. It will have to be an efficient producer, not merely a source of employment, and it must be self-sustaining and subsidy-free. Legislation and policies must be formulated to facilitate these changes. Exchanges of technical and resource management information between developed and undeveloped countries should receive increased attention. Irrigation will require improved water management, reduced project implementation, and lower operation and maintenance costs. Institutions must be retailored and funding responsibilities must be shifted. But the demand for agricultural products will again reach levels where irrigation will be a key ingredient in many countries' activities. (Author's abstract)
W90-00888

CALCULATION OF DISTRIBUTION AND EFFICIENCY FOR NONUNIFORM IRRIGATION.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
A. W. Warrick, W. E. Hart, and M. Yitayew.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 674-686, August 1989. 8 fig, 3 tab, 9 ref, append.

Descriptors: *Irrigation engineering, *Nonuniform flow, *Water distribution, *Soil water, Irrigation efficiency, Deep percolation, Mathematical studies, Numerical analysis, Variability, Field tests, Furrow irrigation, Sprinkler irrigation.

Irrigation applications always exhibit some degree of nonuniformity. The water distribution functions are most often applied to a single irrigation, i.e., a field is irrigated and as a result the water has been distributed areally over the field. The change in soil moisture is dependent upon the distribution and the total amount applied. Nonuniform irrigation was considered with an analysis of distribution, efficiency, and deep percolation. Analytical expressions have been given for normal, lognormal, uniform, and 'specialized power' distributions. Numerical values of area fully irrigated, application efficiency, and deep percolation have been tabulated for all distributions as a function of water applied and variability. Field distributions were successfully compared with theoretical results for two furrow and two sprinkler examples. (Author's abstract)
W90-00890

LP OPERATION MODEL FOR ON-DEMAND CANAL SYSTEMS.
Agricultural Research and Education Center, Fort Pierce, FL.
B. J. Boman, and R. W. Hill.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 687-700, August 1989. 5 fig, 2 tab, 20 ref, append.

Descriptors: *Linear programming, *Model studies, *Computer models, *Irrigation efficiency, *Irrigation engineering, Gates, Irrigation canals, Steady flow, Water shortage, Water demand, Water users, Field tests, Water level fluctuations, Flow rates, Model testing.

A computer model was developed to assist watermasters in making the daily operating decisions required for irrigation water delivery systems which operate under flexible scheduling regimes. The objective of the model, which was formulated for microcomputer use, was to calculate gate discharge rates which would: (1) maintain stable flows in canal reaches; (2) prevent excessive shortages and waste; (3) respond to changes in demand in a timely manner; and (4) supply users with water as close to when they want it as possible. A linear programming (LP) approach was chosen as the optimization technique to minimize the differences between the water order demands of the users and the gate releases. Projected water order demands in each canal reach are input to the model. Water volume balance and physical limitations of the system were used as constraints in the model. The gate releases specified by the model were compared with actual gate releases for a 24,000 hectare irrigation project. Some of the water level fluctuations which occurred in actual operation, when flow rate adjustments were made in response to water level changes, could have been eliminated by using release rates predicted by the model. (Author's abstract)
W90-00891

RESEARCH NEEDS IN IRRIGATION AND DRAINAGE--1989.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 714-721, August 1989. 4 ref.

Descriptors: *Research priorities, *Irrigation requirements, *Drainage programs, *Agricultural engineering, *Water resources management, Technology, Water conveyance, Water control, Water quality, Groundwater, Surface water, Weather modification, Vadose water, Path of pollutants, Social aspects, Political aspects, Environmental policy.

The spatial applicability of current irrigation and drainage research, technological advancements, and institutional problems provide new research opportunities. A research needs list has been developed by the administrative and technological committees of the Irrigation and Drainage Division of the American Society of Civil Engineers (ASCE). The categories include water conveyance and control, plant water requirements, water quality, groundwater, surface water, and weather modification. Priorities among these potential research areas has not been made; however, two critical topics must be emphasized. The quality of water (surface and ground) is of major concern from all segments of the population. Multidisciplinary programs must be developed to improve the measurement and modeling of chemical movement from the vadose zone to aquifer systems, evaluation of

risk of human exposure to contaminated water, etc. Declining water supplies and competition from other uses will probably reduce the level of irrigated agriculture in the western United States. Improved, more economically viable management practices and alternatives must be developed that consider the social, political, and environmental organizations which are increasingly more involved in water resources management. (Author's abstract)
W90-00893

INFILTRATION FUNCTION FROM FURROW STREAM ADVANCE.
Agricultural Research Service, Shafter, CA. Cotton Research Station.
W. R. DeTar.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 722-730, August 1989. 2 fig, 2 tab, 23 ref, append.

Descriptors: *Infiltration rate, *Irrigation engineering, *Furrow irrigation, Soil compaction, Erosion control, Watershed management, Runoff.

Being able to determine infiltration rates in the field is not only important for the proper design of irrigation systems, but it is also an important research tool for characterizing the results of various soil treatments, such as compaction, erosion control, and watershed runoff studies. Average infiltration rates for large land areas can be quickly determined using a new procedure for obtaining the coefficients of the Kostiakov equation. It is a volume-balance method in which the total volume of water entering a furrow is accounted for by the sum of that which infiltrates and that which is stored in the furrow. By introducing the concept of the average opportunity time it is possible to plot the infiltration function directly from tabulated data. This modification of the volume-balance method is a straightforward one, which is easy to understand and learn. (Author's abstract)
W90-00894

HEAD LOSS IN MANIFOLDS OR TRICKLE LATERAL: SIMPLIFIED APPROACH.
Arizona Univ., Tucson. Dept. of Agricultural Engineering.
M. Yitayew.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 739-743, August 1989. 1 tab, 5 ref, append.

Descriptors: *Head loss, *Trickle irrigation, *Irrigation engineering, Mathematical studies, Pressure conduits, Flow discharge, Numerical analysis.

Head loss in manifolds or trickle laterals is an important consideration for optimum design of pressurized irrigation systems. Analytical solutions to the nonlinear differential equation describing typical manifold problems have been recently developed, which yield a relationship between relative discharge and length and can be used to get the total head distribution along the manifold. An extension to these solutions has been presented, having a much-simplified approach for calculating total head loss in manifolds. A numerical example using this equation to calculate the head loss in a manifold using trickle lateral showed good agreement with other approaches. (Fish-PTT)
W90-00897

MODELLING THE IRRIGAITON NEED.
K. A, Holst, and H. B. Madsen.
Acta Agriculturae Scandinavica AASCAU, Vol. 38, p 261-269, 1988. 8 fig, 1 tab, 13 ref.

Decriptors: *Irrigation requirements, *Irrigation engineering, *Hydrologic budget, *Model studies, Evapotranspiration, Root zone, Grasses.

On the basis of a model for daily calculations of the actual evapotranspiration and the water balance in the root zone, the irrigation need for grass and barley has been calculated in relation to root zone capacity and climatic conditions. The results show that the irrigation need is higher for grass than for barley. During the period 1956-85 four years have an extremely high irrigation need while in the mid-sixties there was a long period with a very low need. Curves showing the mean irrigation need in relation to root zone capacity have been elaborated. Furthermore, curves have been constructed combining irrigation need with root zone capacity and the freqnecy of years in which irrigation should be optimal. (Author's abstract)
W90-00957

MANAGEMENT EFFECTS ON RUNOFF, SOIL, AND NUTRIENT LOSSES FROM HIGHLY ERODIBLE SOILS IN THE SOUTHERN PLAINS.
Southern Plains Range Research Station, Woodward, OK.
For primary bibliographic entry see Field 2J.
W90-00959

IRRIGATION STRATEGY SELECTION BASED ON CROP YIELD, WATER, AND ENERGY USE RELATIONSHIPS: A MICHIGAN EXAMPLE.
Michigan State Univ., East Lansing. Dept. of Resource Development.
K. A. Algozin, V. F. Bralts, and J. T. Ritchie.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 5, p 428-431, Sep-Oct 1989. 3 fig, 6 tab, 17 ref.

Descriptors: *Irrigation practices, *Irrigation efficiency, *Michigan, Crop yield, Water use, Energy.

Michigan has experienced a rapid increase in the use of supplemental irrigation. This increase in agricultural water use coincides with similar water use expansion by other sectors of the state, thus establishing the potential for future water use conflicts. The purpose of this analysis was to identify irrigation management strategies that promote the efficient use of water and energy resources. The CERES-Maize corn simulation model was used to generate the necessary crop yield and irrigation data for each strategy considered. An irrigation budget analysis model was used to estimate energy use. The results of the analysis suggests that water-use and energy-use can be achieved through the use of small, frequent applications. (Author's abstract)
W90-00960

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

OPERATION OF A TOWN DRAINAGE SYSTEM BY OUTFLOW CONTROL ON A RAIN RESERVOIR (BEWIRTSCHAFTUNG EINES STADTISCHEN ENTWASSERUNGS-SYSTEMS DURCH ABFLUBSTEUERUNG AN EINEM REGENRUCKHALTEBECKEN).
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wasserguetewirtschaft und Gesundheitsingenieurwesen.
W. F. Geiger, H. Pflueger, and H. Schindler.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80800/GAR. Price codes: E07 in paper copy, A01 in microfiche. 1987. 450p, 129 fig, 20 tab, 77 ref.

Descriptors: *Urban drainage, *Rainfall-runoff relationships, *Drainage canals, *Drainage systems, Model studies, Precipitation, Outflow, Data acquisition, Data processing.

The working basis for the development of outflow control in canal networks were measurements of precipitation and outflow and the associated quality data in a real system. Introductory data on this system concern the area of measurement, the equipment (precipitation and outflow measuring devices, control unit, control circuits and controller) and data collection and data processing. Control concepts and control strategies (solutions, plausibility checks, storage values, quantity emitted, reducing the overflow and its comparative reduction) were then worked out. There are also reports on models of the outflow and control processes (models QUANTUM and SESIM), and on results and operating experience with such a newly designed control system. Finally, control concepts and simulations of different control strategies are dealt with (achievement, errors of measurement, unloading behavior, control depending on load) and the results of different model calculations are given. (Author's abstract)
W90-00191

FLOODS OF NOVEMBER 1978 TO MARCH 1979 IN ARIZONA AND WEST-CENTRAL NEW MEXICO.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2E.
W90-00193

CHANGES IN FLOOD RESPONSE OF THE RED RIVER OF THE NORTH BASIN, NORTH DAKOTA-MINNESOTA.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2E.
W90-00194

MAGNITUDE AND FREQUENCY OF HIGH FLOWS OF UNREGULATED STREAMS IN KANSAS.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W90-00204

LASER-CONTROLLED LAND GRADING FOR FARMLAND DRAINAGE IN THE RED RIVER VALLEY: AN ECONOMIC EVALUATION.
S. Edwardson, D. Watt, and L. Disrud.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 6, p 486-490, November-December 1989. 2 fig, 4 tab, 6 ref.

Descriptors: *Farm management, *Crop production, *Agricultural engineering, *Drainage programs, *Drainage effects, *Grading, Economic evaluation, Lasers.

A study was conducted in the Red River Valley to evaluate the benefits of laser land grading for drainage. Graded fields were compared with ungraded fields to measure changes in crop yields due to better drainage on the graded fields. Cut-and-fill areas were studied in graded fields to evaluate the effect of grading on nutrient levels and crop uniformity. Potential cut-and-fill areas on an ungraded field were also studied for yield uniformity and nutrient levels and compared with the graded field. Crop maturity and yield were more uniform on graded fields (0.05 level of significance) than on ungraded fields. Aerial photographs indicated graded fields had more uniform drainage and, consequently, more uniform crop maturity at harvest. A method is presented for determining the economic feasibility of land grading based upon the percentage of land lost to drown out, the value of the crop, and the cost of grading. The economic analysis indicates that land grading on the areas studied resulted in an 8-year payback and a positive investment return for a longer period of time. (Author's abstract)
W90-00328

GEOLOGY AND SURVIVAL ON THE SNAKE RIVER PLAIN.
For primary bibliographic entry see Field 5G.
W90-00335

CHARACTERIZING FLOOD-PRONE RICE AREAS AND PREDICTING FLOODING HAZARDS.
International Rice Research Inst., Los Banos, Laguna (Philippines). Water Management Dept.
For primary bibliographic entry see Field 2E.
W90-00368

PARTIAL DURATION SERIES METHOD WITH A FIXED NUMBER OF PEAKS.
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2E.
W90-00573

ECONOMIC IMPACT OF MICRO CATCHMENT DEVELOPMENT.
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
C. Kariyawasam.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 568-576, August 1989. 4 fig, 2 tab, 5 ref.

Descriptors: *Water supply, *Reservoir operation, *Rehabilitation, *Economic evaluation, *Economic impact, *Agricultural engineering, Economic prediction, Rice, Farming, Sri Lanka.

In Sri Lanka, an island located near the southern tip of India, there are about 25,000 small reservoirs, commonly known as village tanks, whose irrigable area lies between 1 and 80 hectares. About 50% of these tanks are abandoned and need rehabilitation. In the recent past, the government of Sri Lanka received assistance from several donors to rehabilitate these tanks. Two of the objectives of the rehabilitation program are to increase the small farmer income and increase the paddy production of the country. When a large number of village tanks are located within the catchment of a major reservoir, rehabilitation can result in a negative impact on the economy. A model has been developed to assess such impact. The results of the four systems of reservoirs studied indicates that the maximum economic benefits are obtained when about 60% of the village tanks are rehabilitated. If rehabilitation is carried out beyond this critical level, there is a net reduction of paddy production from the system of reservoirs. (Author's abstract)
W90-00882

STABLE PREDICTIVE CONTROL OF OPEN-CHANNEL FLOW.
Universidad Politecnica de Cataluna, Barcelona (Spain). Dept. of Applied Mathematics.
For primary bibliographic entry see Field 8A.
W90-00892

RESPONSE OF MUSKINGUM EQUATION TO STEP INPUT.
Detroit Water and Sewerage Dept., MI.
For primary bibliographic entry see Field 2E.
W90-00896

LIMITATION OF THE FORECASTING HORIZON IN STOCHASTIC DYNAMIC PROGRAMMING FOR DAM OPERATION (LIMITATION DE L'HORIZON PREVISIONNEL DE LA PROGRAMMATION DYNAMIQUE STOCHASTIQUE EN MATIERE DE GESTION DE BARRAGES).
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
Z. X. Fang, B. Voron, and C. Bocquillon.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 405-414, August 1989. 2 fig, 12 ref. English summary.

Descriptors: *Reservoir operation, *Stochastic models, *Dynamic programming, Forecasting, Limiting factors, Computers.

This paper presents a procedure for a stochastic dynamic programming model that has performance of classical stochastic dynamic programming but requires less computation time. The approach is based upon the considerations that forecasting beyond a certain time has little effect and that this effect can be estimated. It means that the forecasting horizon can be limited to time periods less than those usual in dynamic programming. An application of the method for autoregressive flow show that the forecasting horizon can be restricted to four weeks for some time periods such that real-time dam operating problems can be solved with a micro-computer. (Author's abstract)
W90-00938

DYNAMIC PROGRAMMING: APPLICATION TO MANAGEMENT OF AN IRRIGATION RESERVOIR (PROGRAMMATION DYNAMIQUE: APPLICATION A LA GESTION D'UNE RETENUE POUR L'IRRIGATION).
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
Z. X. Fang, B. Voron, and C. Bocquillon.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 415-424, August 1989. 1 fig, 7 ref. English summary.

Descriptors: *Reservoir operation, *Dynamic programming, *Model studies, *Multipurpose reservoirs, *Irrigation operation, Water supply, Water demand, Water deficit, Electric power production.

A dynamic programming model is presented for reservoir whose main purpose is to satisfy agricultural water needs. Other purposes which must be taken into consideration are drinking water supply and hydropower production. An approach is proposed to determine the crop yield response to water deficits. A particular state variable (crop state) is defined for stating the optimization problem of the reservoir operation as a classical dynamic programming one. The different hydrological and climatological random variables are treated with different statistical assumptions. The irrigation water demand is forecast, but only the expected value is taken into consideration for simplification. Stochastic programming is used with a Markov model for weekly flow forecasting. An example is presented to examine the proposed models. (Author's abstract)
W90-00939

OPERATION OF WATER SUPPLY RESERVOIRS BY 'CONTROL BANDS' DERIVED BY SIMULATION.
Durban-Westville Univ. (South Africa). Dept. of Civil Engineering.
A. J. Tollow.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 449-463, August 1989. 4 fig, 20 ref.

Descriptors: *Water supply, *Reservoir operation, *Simulation, Optimization, Computers, England.

Simulation is one method used to derive control rules. It is non-optimal. One way of circumventing the non-optimality is to employ a 'control band', which may in some respects be likened to a permissible deviation from the mean (the control rule). The concept is applicable to both on-stream and off-stream reservoirs. The systems where the idea was developed were the Ely Ouse-Essex and later Rutland Water in the UK. The start was a 'family' of simulation-derived operating rules for each reservoir. Both mainframe and microcomputers were used for the Rutland Water simulation and subsequent operations. The aim was to develop an operating strategy for deployment by the controllers. Only in severe climatic abnormality would the hydrologist need to modify the programme. Warnings that problems were developing would be highlighted when actual problems were developing would be highlighted when actual reservoir levels were seen to fall outside the 'control band'. the paper gives reasons for making use of simulation and indicates some of the benefits. Possible future work to upgrade both the operation and the development of both schemes is suggested. Although simulation was used in the two cases quoted, the basic idea may also be readily adapted to forms of linear programming. Continued development of the concept of the 'control band' is possible. (Author's abstract)
W90-00941

4B. Groundwater Management

MODELING SUBSURFACE DRAINAGE AND WATER MANAGEMENT SYSTEMS TO ALLEVIATE POTENTIAL WATER QUALITY PROBLEMS.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W90-00016

RESOURCE DOCUMENT: FOR THE CONSIDERATION OF THE TULALIP AQUIFER AS A SOLE SOURCE AQUIFER.
Environmental Protection Agency, Seattle, WA. Office of Ground Water.
For primary bibliographic entry see Field 2F.
W90-00144

SUBSURFACE STORAGE OF FRESHWATER IN SOUTH FLORIDA: A DIGITAL MODEL ANALYSIS OF RECOVERABILITY.
Geological Survey, Miami, FL. Water Resources Div.
M. L. Meritt.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2261, 1985. 44p, 20 fig, 1 tab, 24 ref.

Descriptors: *Saline-freshwater interfaces, *Model studies, *Groundwater reservoirs, *Water storage, *Florida, *Hydraulic models, *Groundwater budget, Geohydrology, Aquifers, Injection, Groundwater mining, Solute transport, Groundwater movement.

As part of a study of the feasibility of recovering freshwater injected and stored underground in south Florida, a digital solute transport model was used to investigate the relation of recovery efficiency to the variety of geohydrologic conditions that could prevail in brackish artesian aquifers and to a variety of management alternatives. A loss of recovery efficiency is caused by: (1) processes causing mixing of injected freshwater with native saline water (hydrodynamic dispersion), (2) processes causing the more or less irreversible displacement of the injected freshwater with respect to the well (buoyancy stratification, background hydraulic gradients, and interlayer dispersion), or (3) processes causing injection and withdrawal flow patterns to be dissimilar (directionally biased wellbore plugging, and dissimilar injection and withdrawal schedules in multiple-well systems). Other results indicated that recovery efficiency improves considerably with successive cycles, providing that each recovery phase ends when the chloride concentration of withdrawn water exceeds established criteria for potability (usually 250 mg/L), and that freshwater injected into highly permeable or highly saline aquifers (such as the 'boulder zone') would buoy rapidly. Many hydrologic conditions were posed for model analysis. To have obtained comparable results with operational testing would have been more costly by orders of magnitude. (Lantz-PTT)
W90-00200

WELL SYSTEM TO RECOVER USABLE WATER FROM A FRESHWATER-SALTWATER AQUIFER IN PUERTO RICO.
Geological Survey, San Juan, PR. Water Resources Div.
A. L. Zack.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2328, 1988. 15p, 13 fig, 3 ref.

Descriptors: *Puerto Rico, *Groundwater management, *Wells, *Potable water, *Coastal aquifers, Saline water intrusion, Aquifers, Groundwater quality, Groundwater mining, Groundwater movement, Chlorides.

Aquifers in coastal areas of Puerto Rico commonly contain limited quantities of freshwater that occur as a thin layer at the surface of the water table. Many wells have been abandoned because well screens were inadvertently placed in saltwater parts of the aquifer. A scavenger/production well couple that can be installed in an abandoned well, screened in both freshwater and saltwater parts of the aquifer, provides an effective method for extracting freshwater from the well. Withdrawal of a sufficient quantity of water having low chloride concentrations, by use of a well couple, depends on the upward movement of saltwater within the aquifer when the well is pumped. Upward movement of saltwater depends on the relative concentrations of chloride in the borehole and on the

distribution of horizontal and vertical hydraulic conductivity of the aquifer. For any well screened in an aquifer that contains both freshwater and saltwater, a family of curves can be constructed to represent all combinations of pumping rates and corresponding chloride loads when the scavenger well and the production well are being pumped simultaneously. The curves permit estimates of optimal withdrawals of freshwater based on the desired pumping rates and the levels of chloride concentration required for each well. (Author's abstract)
W90-00225

GROUNDWATER RESTORATION FIELD TEST AT THE HOE CREEK UNDERGROUND COAL GASIFICATION SITE.
University of Wyoming Research Corp., Laramie. Western Research Inst.
For primary bibliographic entry see Field 5G.
W90-00245

ASSESSMENT OF GROUNDWATER POTENTIAL FOR CONJUNCTIVE WATER USE IN A LARGE IRRIGATION PROJECT IN INDIA.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. K. Sondhi, N. H. Rao, and P. B. S. Sarma.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 283-295, March 30 1989. 6 fig, 3 tab, 9 ref.

Descriptors: *Conjunctive use, *Water use, *Groundwater potential, *India, *Surface-groundwater relations, *Irrigation engineering, Irrigation practices, Spatial distribution, Irrigation programs, Groundwater recharge.

In many large-surface irrigation projects, the potential for groundwater development has increased significantly. The additional potential can be used to develop conjunctive water management plans for augmenting canal water supplies and increasing agricultural productivity in the project area, if its spatial distribution is also known. A methodology for determining the available additional groundwater potential and its distribution in the Mahi Right Bank Canal Project in Gujarat is presented. The procedure is based on the use of specific empirical constants for estimating groundwater recharge from the water conveyance and distribution system and the annual water balance of the project. The spatial distribution of groundwater potential is determined by 'recharge distribution coefficients' derived from a digital simulation model of the groundwater basin of the project area. The available annual groundwater potential in the Mahi Right Bank Canal project in India is about 265 x 10 to the sixth power m to the third power. This is about 1.6 times the existing level of groundwater abstraction. The spatial distribution of this potential over the project area is not uniform. It is relatively high in the central and southern portions of the project area and is low at the northern and western boundaries. (Author's abstract)
W90-00367

WATER FARMS AND TRANSFER CONFLICTS IN ARIZONA, USA: A PROPOSED RESOLUTION PROCESS.
Department of Geography and Regional Development, University of Arizona, Tucson, AZ 85721.
For primary bibliographic entry see Field 6E.
W90-00453

GROUNDWATER TABLE SIMULATION UNDER DIFFERENT RICE IRRIGATION PRACTICES.
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 3F.
W90-00879

EFFECT OF WATER DEPTH IN GROUNDWATER RECHARGE BASINS ON INFILTRATION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2G.
W90-00881

URBAN GROUNDWATER RISE CONTROL: CASE STUDY.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W90-00884

4C. Effects On Water Of Man's Non-Water Activities

DEVELOPMENTS IN ECOLOGICAL MODELLING.
Royal Danish School of Pharmacy, Copenhagen. Dept. of Pharmaceutical Chemistry.
For primary bibliographic entry see Field 7C.
W90-00003

IMPACTS OF A PROPOSED COAL MINE IN THE FLATHEAD RIVER BASIN.
International Joint Commission-United States and Canada, Washington, DC.
December 1988. 26p, 2 append.

Descriptors: *Resources development, *Environmental effects, *Coal mine effects, *Ecological effects, *Coal mines, *Flathead River, Water pollution prevention, Evaluation, Management planning, Fish, Project planning, International waters, Watershed management.

In parallel letters from the Governments of the United States and Canada in December 1984 and February 1985 respectively, the International Joint Commission was requested to examine and report on the water quality and quantity of the Flathead River, with respect to the transboundary water quality and quantity implications of the proposed coal mine on Cabin Creek, a tributary of the Flathead River. Following this examination, the Commission recommends that, in order that Governments can ensure that the provisions of Article IV of the Boundary Waters Treaty are honored in the matter of the proposed coal mine at Cabin Creek in British Columbia: (1) the mine proposal as presently defined and understood not be approved; (2) the mine proposal not receive regulatory approval in the future unless and until it can be demonstrated that the potential transboundary impacts identified in the report of the Flathead River International Study Board have been determined with reasonable certainty and would constitute a level of risk acceptable to both Governments, and the potential impacts on the sport fish populations and habitat in the Flathead River system would not occur or could be fully mitigated in an effective and assured manner; and (3) the Governments consider, with the appropriate jurisdictions, opportunities for defining and implementing compatible, equitable and sustainable development activities and management strategies in the upper Flathead River basin. (Lantz-PTT)
W90-00128

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS.
Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2268, 1987. 68p, 23 fig, 26 tab, 45 ref.

Descriptors: *Mining effects, *Water pollution sources, *Groundwater pollution, *Groundwater quality, *Lead, *Zinc, *Kansas, Mine drainage, Aquifers, Sulfates, Silica, Cadmium, Manganese, Iron, Dissolved solids, Fate of pollutants.

A study was conducted to evaluate water resources problems related to abandoned lead and zinc mines in Cherokee County, Kansas, and adjacent areas in Missouri and Oklahoma. Past mining activities have caused changes in the geohydrology of the area. Discharge of mine-contaminated groundwater to Tar Creek occurs in Oklahoma from drill holes and shafts where the potentiometric surface of the shallow aquifer is above the land surface. Pumping of the deep aquifer has resulted in a potential for downward movement of water from the shallow aquifer. Water from mines in the eastern area contained dissolved solids concentrations of < 500 mg/L a median pH of 3.9, sulfate concentrations that ranged between 98 and 290 mg/L, and median concentrations for zinc of 37,600 micrograms/L (ug/L) for lead of 240 ug/L, for cadmium of 180 ug/L, for iron of 70 ug/L, for manganese of 240 ug/L, and for silica of 15 mg/L. Water from mines in the western area contained dissolved solids concentrations of generally > 500 mg/L, a median pH of 6.8, sulfate concentrations that ranged between 170 and 2,150 mg/L, and median concentrations for zinc of 3,200 ug/L, for lead of 0 ug/L (minimum detection limit is 10 ug/L, for cadmium of 6 ug/L, for iron of 840 ug/L, for manganese of 440 ug/L, and for silica of 11 mg/L. No conclusive evidence of lateral migration of water from the mines into domestic well water supplies in the shallow aquifer was found in the study area in Kansas. Effects of abandoned lead and zinc mines on tributaries of the Spring River in the eastern area are most severe in Short Creek. Drainage from tailings cause large concentrations of sulfate, zinc, and cadmium in Tar Creek in Kansas. Compared with four other major streams in the western area in Kansas, Tar Creek contained the largest low flow concentrations of sulfate (910 mg/L), zinc (5,800 ug/L), and cadmium (40 ug/L). (Lantz-PTT)
W90-00201

RELATION OF URBAN LAND-USE AND DRY-WEATHER, STORM, AND SNOWMELT FLOW CHARACTERISTICS TO STREAM-WATER QUALITY, SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS.
Geological Survey, Lawrence, KS. Water Resources Div.
L. M. Pope, and H. E. Bevans.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2283, 1987. 39p, 17 fig, 11 tab, 21 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Rainfall-runoff relationships, *Land use, *Water quality, *Environmental effects, *Flow profiles, Lead, Zinc, Runoff, Drought, Storm runoff, Sodium, Dissolved solids, Chlorides, Overland flow.

An investigation was conducted to provide the data and interpretation necessary to determine the effects of runoff from urban areas on the water quality characteristics of receiving streams. Water quality characteristics for three streamflow conditions were determined: (1) dry weather streamflow--a combination of base flow and point source contributions, (2) storm streamflow--mainly provided by overland runoff from storms, and (3) snowmelt streamflow--mainly provided by overland runoff from snowmelt. Median concentrations of trace metals and nutrients were larger in storm streamflow than in dry weather streamflow. Median concentrations of total lead and zinc were largest in storm streamflow from the more urban basins. Median concentrations of dissolved sodium, chloride, and solids in snowmelt streamflow at all study sites averaged 218% larger for dissolved sodium, 296% larger for dissolved chloride, and 71% larger for dissolved solids relative to median concentrations in dry weather streamflow. Multiple correlation and regression analysis relating storm runoff volumes and average constituent concentrations to land use and storm characteristics produced significant relations for storm runoff volume, total lead, total zinc, and suspended sediment. (Lantz-PTT)
W90-00205

RELATIONS BETWEEN QUALITY OF URBAN RUNOFF AND QUALITY OF LAKE ELLYN AT GLEN ELLYN, ILLINOIS.
R. G. Striegl, and E. A. Cowan.

Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2301, 1987. 59p, 27 fig, 20 tab, 60 ref.

Descriptors: *Urban hydrology, *Water pollution sources, *Water quality, *Urban runoff, *Lake Ellyn, *Illinois, Chemical analysis, Suspended sediments, Organic compounds, Seasonal variation, Limnology, Lake sediments, Metals.

Comparison of flow and chemical data collected at the principal inlet and at the outlets of Lake Ellyn--an urban lake in the Chicago metropolitan area shows that detention storage alters the discharge and the quality of urban runoff. Peak water discharge and variation in the concentration of constituents transported by the runoff are usually reduced. Mass balance relations based on comparison of measured constituent loads at the inlet and the outlets show that the lake is very efficient in trapping suspended solids, suspended sediment, and sediment-associated metals. Calculated trap efficiencies for many dissolved constituents were negative. However, negative efficiencies appear to be influenced mostly by insufficient sampling in winter. Trap efficiencies for nitrogen and phosphorus are intermediate to those determined for other constituents. Solids accumulate on the lake bottom as organic-rich muds that reduce lake storage and cover potential habitat for aquatic organisms. Lake sediments, particularly fine-grained sediments, have elevated concentrations of metals associated with them. Several organic compounds, not detected in inlet or outlet water samples, were detected in a lake sediment sample collected near the inlet. Concentrations of many constituents dissolved in lake water are seasonally cyclic, with annual concentration peaks occurring during the winter. Establishment and maintenance of desirable benthic invertebrate and fish populations appear to be inhibited by sediment deposition. (Author's abstract)
W90-00212

NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT IN INDONESIA: AN OVERVIEW.
Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 6A.
W90-00250

RESPONSE OF FISH COMMUNITIES TO HABITAT ALTERATION IN A SMALL OZARK STREAM.
Forest Service, Russellville, AR.
D. J. Ebert, and S. P. Filipek.
Proceedings of the Arkansas Academy of Science AKASAO, Vol. 42, p 28-32, 1988. 3 tab, 40 ref.

Descriptors: *Aquatic habitats, *Lotic environment, *Stream biota, *Channeling, *Highway effects, *Fish populations, *Streams, Streamflow, Biomass, Arkansas, Riparian vegetation, Particle size, Species composition, Low flow, Channel erosion.

From 1984 to 1986, the Arkansas Highway and Transportation Department reconstructed and upgraded a portion of State Highway 123 west of State Highway 7. As a result of the construction, portions of Haw Creek, a third order stream in the Boston Mountains Ecoregion, were straighte ed and channelized. In reconstructing stream reaches, stream banks were riprapped and vegetated, gabions constructed and positioned, stream substrates and pool/riffle ratios altered. Channelized reaches became wide and shallow, lacking overstory cover and pools. Substrate particle size changed from boulder/rubble to rubble/gravel/sand and velocity increased. Campostoma anomalum, Notropis boops, and Etheostoma spectabile accounted for more than 80 percent of all fish captures. This represented a shift from piscivore and insectivore/piscivore to herbivore and insectivore dominated feeding guilds. Natural channel reaches had more complex fish communities and greater abundance of sunfish and catfish (primarily deeper water groups). Immediately after channelization, altered reaches had a larger biomass than natural reaches (0.43-0.26 g/sq m). The summer following alteration channeled segements were nearly dry and biomass decreased dramatically (0.06-0.11 g/sq m). One year post channelization, altered reaches had eroded, scoured and deepened at their headwaters, and embedded. Fish community composition in altered reaches stabilized to a riffle-type assemblage dominated by the herbivore Campostoma anomalum. (Author's Abstract)
W90-00282

PERCIVAL CREEK CORRIDOR PLAN.
Thurston Regional Planning Council, Olympia, WA.
For primary bibliographic entry see Field 6B.
W90-00326

BIOECONOMIC APPROACH TO ESTIMATING THE ECONOMIC EFFECTS OF WATERSHED DISTURBANCE ON RECREATIONAL AND COMMERCIAL FISHERIES.
California Univ., Davis. Div. of Environmental Studies.
J. B. Loomis.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 1, p 83-87, January-February 1989. 1 fig, 2 tab, 27 ref.

Descriptors: *Clear-cutting, *Forest management, *Commercial fishing, *Montana, *Cost-benefit analysis, *Fisheries, *Sport fishing, *Logging, *Recreation, Watershed management, National parks, Siuslaw National Forest, Porcupine-Hyalite Wilderness.

The change in value of recreational and commercial fisheries caused by timber harvesting and road building on two national forests was measured using an improved bioeconomic approach. Hydrologic models were linked with fisheries models to predict the change in catchable fish populations due to watershed disturbances from road building and timber harvests. A simple bioeconomic model of recreational fishing, estimated using the travel-cost method, was applied to measure the incremental change in economic value of the fisheries under different levels of watershed disturbance. The results indicated that, for the Siuslaw National Forest, clearcutting on about 87,000 acres resulted in a loss of about 84,000 salmon and 24,000 steelhead trout over the 30-year period studied. The economic value of these lost fish to recreational and commercial anglers is $2 million. For the Porcupine-Hyalite Wilderness study area in Montana, the results indicated a $3.5 million loss in the value of trout fishing over a 50-year period from timber harvesting in the Gallatin and Yellowstone River drainages. (Author's abstract)
W90-00333

LAND USE IMPACTS OF PRIVATE SEWAGE SYSTEMS IN WISCONSIN.
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
H. M. Jacobs, and M. E. Hanson.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 2, p 149-152, March-April 1989. 3 fig, 1 tab, 15 ref.

Descriptors: *Land development, *Septic tanks, *Mound sewage systems, *Wastewater treatment, *Sewer systems, *Land use, *Wisconsin, Land management, Urbanization, On-site systems.

Rural and suburban development has been and will continue to depend upon private on-site sewage disposal systems. Changing technologies (such as mound systems) for sewage disposal that reduce site limitations to development have raised a broad set of land use concerns. Based on a study in Wisconsin, the impacts of new sewage technologies on rural sprawl and agricultural and forest land conversion were no different than that of conventional on-site systems. The policy mechanisms most suited to mitigating settlement impacts are settlement policies, that is, land use policies. Private sewage system policy by itself is a limited and indirect approach to mitigating these impacts. The long-term environmental, fiscal, and land use impacts of mounds and holding tanks are not yet clear. Mounds have not yet reached their design life, and issues of their on-site failure and how and where on-site replacement will occur have not been addressed fully. It is only recently that municipalities and the state have begun to become aware of the complexities and costs of the disposal of holding tanks septage. If, as it appears, these problems will grow in time, this may lead to interest in land use planning. (Author's abstract)
W90-00336

IN SITU NUTRIENT ENRICHMENT EXPERIMENTS WITH PERIPHYTON IN AGRICULTURAL STREAMS.
Iowa State Univ., Ames. Dept. of Animal Ecology.
S. J. Bushong, and R. W. Bachmann.
Hydrobiologia HYDRB8, Vol. 178, No. 1, p 1-10, July 10, 1989. 2 fig, 4 tab, 32 ref.

Descriptors: *Land use, *Streams, *Algae, *Limiting nutrients, *Nitrogen, *Phosphorus, Water temperature, Streamflow, Storms.

Four agricultural streams were examined to determine if N or P was limiting the growth of the attached algal communities. Experiments were conducted in situ using nutrient-diffusing artificial substrata. Experiments conducted over a 2-year period demonstrated that the benthic algal communities in these streams were seldom limited by N or P. N was, however, found limiting on two occasions when ambient N levels were reduced. These experiments were characterized by extended low flows and warm water temperatures. Large algal mats which proliferate during these periods may be responsible for reducing the available N to a limiting level. Major storm events are thought to interrupt the development of N limiting conditions by scouring the algae and increasing the N loading from the watershed. Water temperature was demonstrated as an important factor in controlling periphyton growth rates and may have influenced algal response to nutrient input. Ammonium additions often enhanced algal growth in the absence of nitrate stimulation. (Author's abstract)
W90-00401

POTENTIAL WIND AND WATER ERODIBILITY OF FOUR LAND-USE SYSTEMS IN SOUTH-EASTERN MONTANA, U.S.A.
Montana State Univ., Bozeman. Dept. of History and Philosophy.
For primary bibliographic entry see Field 2J.
W90-00434

ROLE OF THE MISSISSIPPI RIVER IN WETLAND LOSS IN SOUTHEASTERN LOUISIANA, U.S.A.
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
For primary bibliographic entry see Field 6G.
W90-00446

GRAVEL TRANSPORT, GRAVEL HARVESTING, AND THE CHANNEL-BED DEGRADATION IN RIVERS DRAINING THE SOUTHERN OLYMPIC MOUNTAINS, WASHINGTON, U.S.A.
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W90-00449

MIGRATION AND CONTROL OF PURPLE LOOSESTRIFE (LYTHRUM SALICARIA L.) ALONG HIGHWAY CORRIDERS.
National Fisheries Research Center-Great Lakes, Ann Arbor, MI.
D. A. Wilcox.
Environmental Management EMNGDC, Vol. 13, No. 3, p 365-370, May-June 1989. 4 fig, 1 tab, 13 ref.

Descriptors: *Weed control, *Aquatic weeds, *Environmental effects, *Highway effects, *Plant growth, *Flowering, *Purple loosestrife, *Intro-

duced species, Distribution patterns, Spatial distribution.

The east-west density gradient and the pattern and mode of migration of the wetland exotic, purple loosestrife (Lythrum salicaria) L.) were assessed in a survey of populations along the New York State Thruway from Albany to Buffalo to determine if the highway corridor contributed to the spread of this species. During the peak flowering season of late July to early August, individual colonies of purple loosestrife were identified and categorized into three size classes in parallel belt transects consisting of the median strip and highway rights-of-way on the north and south sides of the road. Data were also collected on the presence of colonies adjacent to the corridor and on highway drainage patterns. Although a distinct east-west density gradient existed in the corridor, it corresponded to the gradient on adjacent lands and was generally influenced by a major infestation at Montezuma National Wildlife Refuge. The disturbed highway corridor served as a migration route for purple loosestrife, but topographic features dictated that this migration was short-distance rather than long-distance process. Ditch and culvert drainage patterns increased the ability of purple loosestrife to migrate to new wetland sites. Management strategies proposed to reduce the spread of this wetland threat include minimizing disturbance, pulling by hand, spraying with glyphosate, disking and mowing. (Author's abstract)
W90-00458

DIMINISHING DISCHARGES OF MOUNTAIN SPRINGS IN A PART OF KUMAUN HIMALAYA.
Kumaun Univ., Naini Tal (India). Dept. of Geology.
K. S. Valdiya, and S. K. Bartarya.
Current Science CUSCAM, Vol. 58, No. 8, p 417-426, April 20 1989. 8 fig, 2 tab, 11 ref.

Descriptors: *Hydrological regime, *India, *Land use, *Water supply, *Erosion, *Springs, Water resources, Deforestation, Gaula River.

An appraisal of fast-changing land use patterns and their impact on water resources was conducted. A land use map was prepared on the basis of field surveys carried out in 1984-85 during geological and hydrogeological investigations, and compared with the Survey of India toposheets of 1963 and with the landsat photo of 1973. It was found that deforestation of vulnerable slopes has led to a 13.1% reduction of the protective forest cover in the 22 years prior to 1985. This has accelerated erosion to a rate of 170.3 cm/1000 years which has greatly affected the hydrologic regime in the catchment of the Gaula River, a tributary of the Ramganga in the Kumaun Himalaya. These changes have resulted in the drying up of springs and diminished discharges in more than 40% of the villages in the Gaula catchment. During the past 5 to 50 years discharge decreases have ranged from 25 to 75%, and the flow in the Gaula River has decreased 29.2% between 1951-60 and 1961-70, and 38.5% between 1971 and 1981. In addition, decreases in rainfall amounting to 9.5 to 76% have occurred between 1958 and 1986 in many parts of the catchment area and upstream water has been increasingly used for irrigation of cropland. (White-Reimer-PTT)
W90-00562

RECENT MODIFICATIONS OF THE AQUATIC VEGETATION IN THE ETANG DU VACCARES (CAMARGUE, FRANCE) IN RELATION WITH THE HUMAN DISTURBANCES (MODIFICATIONS RECENTES DE LA VEGETATION AQUATIQUE DE L'ETANG DU VACCARES (CAMARGUE, FRANCE) LIEES AUX PERTURBATIONS ANTHROPIQUES).
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W90-00600

CHANGES IN STREAM ORGANIC MATTER FOLLOWING WATERSHED DISTURBANCE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
S. W. Golladay, J. R. Webster, and E. F. Benfield.
Holarctic Ecology HOECD2, Vol. 12, No. 2, p 96-105, June 1989. 3 fig, 5 tab, 45 ref. NSF Grants BSR 8316000 and BSR 8012093.

Descriptors: *Logging, *Forest hydrology, *Land use, *Organic matter, *Streams, Environmental impact, Watersheds, Trees, Leaves, North Carolina.

Benthic organic matter was collected quarterly from streams draining a nine year old clearcut, an eighteen year old old-field, a twenty-five year old successional forest, and two reference watersheds at Coweeta Hydrologic Laboratory in the Appalachian Mountains of North Carolina. Samples were separated into large benthic organic matter (LBOM >1 mm) and fine benthic organic matter (FBOM <1 mm). Standing stocks of LBOM ranged from 124 to 255 g/sq m AFDM (ash free dry mass) and were significantly higher in streams draining reference watershed and the successional forest than in either the recent clearcut or old-field. Reference sites exhibited LBOM peaks in late autumn and spring. No seasonal patterns were observed in disturbed streams. Standing stocks of FBOM averaged 113 to 387 g/sq m AFDM, and the stream draining the successional forest had significantly higher FBOM levels than the other sites. In reference streams, FBOM abundance peaked in spring. In disturbed streams, FBOM standing stocks were highest in summer or late autumn. Standing stocks of large wood ranged from 0 to 3956 g/sq m AFDM and were significantly higher in the reference streams than in streams draining the old-field or successional forest. Comparisons of organic matter inputs with standing stocks indicated that disturbed streams at Coweeta receive less material and process it faster than reference streams. (Author's abstract)
W90-00691

SPATIAL VARIATION IN FISH COMMUNITIES IN TWO SOUTH-WESTERN AUSTRALIAN RIVER SYSTEMS.
Western Australia Univ., Nedlands. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-00692

COPPER AND ZINC BALANCE IN SOILS, RICE PLANTS AND AQUATIC SYSTEMS IN AN AREA ALONG THE FUCHU PRECIPICE LINE, TOKYO, JAPAN.
Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture.
M. Okazaki, and S. Saito.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 265-275, February 1989. 5 fig, 6 tab, 11 ref.

Descriptors: *Water pollution sources, *Urbanization, *Irrigation water, *Soil water, *Heavy metals, *Irrigation canals, *Japan, Groundwater, Copper, Zinc.

The abundance and distribution of Cu and Zn in spring water, irrigation water and sediment from the Fuchu Irrigation Canals, ground water for irrigation, rice plants and paddy soil at Tokyo University of Agriculture and Technology's Hommachi Farm were studied. The balance of Cu and Zn in the paddy field at the Hommachi Farm was investigated. The discharge of Cu and Zn influenced by human activities was observed in sediment of the Fuchu Irrigation Canal, and rice plants and paddy soil at the Hommachi Farm where irrigation water from the Fuchu Irrigation Canal was used until 1970. From Cu and Zn balance calculated, several hundred years are needed to decrease by half the present level of these metals at the Hommachi Farm. (Author's abstract)
W90-00811

URBAN GROUNDWATER RISE CONTROL: CASE STUDY.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
O. S. Abu-Rizaiza, H. Z. Sarikaya, and M. Z. Ali Khan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 588-607, August 1989. 15 fig, 2 tab, 5 ref, append.

Descriptors: *Urban hydrology, *Wastewater disposal, *Groundwater management, *Groundwater level, *Water quality control, *Drainage systems, Soil conservation, Cesspools, Leachates, Wastewater pollution, Groundwater recharge, Vertical flow, Observation wells, Hydraulic conductivity, Sewer systems, Irrigation districts, Urban drainage, Computer programs, Saline water, Saudi Arabia.

Seepage of wastewater from cesspools, and of leachate from green areas and parks, results in an annual groundwater rise of 0.5 meters in Jeddah, Saudi Arabia. The rise causes several environmental and structural problems. A network of 110 observation wells has been built to collect information regarding groundwater conditions, and to estimate soil settlement rates under different groundwater lowering conditions, and soil drainage rates. The hydraulic conductivity values range from 0.3 to 0.4 meters per day. The groundwater recharge is mainly from cesspools and irrigated areas and its rate ranges from 0.6 to 1.2 millimeters per day. Three alternates, namely sanitary sewer, vertical drainage, and horizontal drains are evaluated. The horizontal drainage system is selected and a procedure is presented for its design in urban areas. Computer programs are developed for the analysis of steady and nonsteady flows into drains. Vitrified clay pipe material is selected because of its local availability and resistance to corrosion. The drained water is not suitable for irrigation because of its high salinity and sodium hazard. However, the quality of the drained water meets the local sea-discharge standards, and is therefore discharged into the Red Sea. (Author's abstract)
W90-00884

WATER RECREATION AND RISK.
Water Research Centre, Medmenham (England).
R. F. Lacey, and E. B. Pike.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 13-18, February 1989. 15 ref.

Descriptors: *Recreation, *Risk assessment, Water quality standards, Swimming, Bioindicators.

This paper deals with concepts and methods that may be used in the assessment and management of risks associated with aquatic recreation. It aims to explore potential approaches and to indicate their strengths and weaknesses. The paper concentrates on hazards encountered in bathing, swimming and water-contact sports that may be affected by water quality. Aspects discussed include: the role of society in regulating risks that are taken voluntarily by individuals; the difficulties of measuring those risks by means of epidemiological studies; the questionable predictive power of bacterial indicators and the problem of finding a satisfactory rationale for determining the standards for recreational waters. (Author's abstract)
W90-00923

4D. Watershed Protection

SPILLWAY PERFORMANCE REPORT, MISSISSIPPI, DECEMBER 1982.
Soil Conservation Service, Washington, DC. Engineering Div.
For primary bibliographic entry see Field 8B.
W90-00135

TERRESTRIAL ECOLOGY OF LOWER COLORADO RIVER BANKLINE MODIFICATIONS.
SWCA, Inc., Tucson, AZ.
For primary bibliographic entry see Field 6G.
W90-00148

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

IDENTIFICATION OF TRACE ORGANIC SUBSTANCES IN SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
L. B. Barber, E. M. Thurman, and M. P. Schroeder.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p B19-B20, 8 ref.

Descriptors: *Pollutant identification, *Trace levels, *Wastewater pollution, *Organic compounds, *Groundwater pollution, Aquifers, Cape Cod, Wastewater disposal, Trichloroethylene, Tetrachloroethene, Water pollution sources, Organic carbon, Volatile organic compounds, Groundwater movement, Infiltration, Plumes.

The distribution of dissolved organic compounds in a sand and gravel aquifer on Cape Cod, was studied in a plume of sewage contaminated groundwater. The plume resulted from disposal of secondary-treated sewage by rapid infiltration at Otis Air Base. Maximum dissolved organic carbon (DOC) concentrations in the plume were 5 mg/L, whereas those in uncontaminated groundwater at the site were 0.7 mg/L. Although these data suggest that the groundwater is not heavily contaminated by organic compounds, water with very low DOC concentrations can contain undesirable levels of toxic organic substances. Therefore, methods to identify trace organic compounds were tested at the site. Three methods were used to isolate trace organic compounds from groundwater samples: closed-loop stripping, purge and trap, and liquid extraction. Identification and quantification of compounds were performed by gas chromatography/mass spectrometry (GC/MS). Concentrations of volatile organic compounds (VOC) determined by closed-loop stripping and purge and trap were generally comparable, with two major differences: (1) the closed-loop stripping indicated a greater extent of trichloroethylene (TCE) and tetrachloroethene (PCE) contamination than did purge and trap because closed-loop stripping has a lower detection limit, and (2) in samples where TCE and PCE concentrations > 10 micrograms/L, concentrations determined by closed-loop stripping were considerably lower than concentrations determined by purge and trap. A general trend of increasing concentrations in the downgradient part of the plume and decreasing concentrations near the infiltration beds suggests that VOCs were introduced as a pulse and are moving downgradient with the groundwater flow. Most of the readily degradable dissolved organic carbon (DOC) in the sewage is removed during treatment and infiltration at the disposal site. The remaining refractory DOC compounds reach the water table and were detected as far as 11,000 ft from the infiltration beds. (See also W90-00022) (Lantz-PTT)
W90-00030

PROBLEMS ASSOCIATED WITH THE ANALYSIS OF PLANT SAMPLES IN THE TAR CREEK STUDY.
Geological Survey, Denver, CO.
B. M. Erickson, T. F. Harms, and L. H. Filipek.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p D17-D20, 2 fig, 2 tab, 4 ref.

Descriptors: *Tissue analysis, *Plant tissues, *Pollutant identification, *Tar Creek, Chemical analysis, Vegetation, Emission spectroscopy, Atomic absorption spectrophotometry, Zinc, Fate of pollutants, Biological samples, Oklahoma.

The lead-zinc mines in northeastern Oklahoma were abandoned in the 1950's and 1960's. Since 1980, mine water high in Cd, Fe, Pb, and Zn has been discharging and entering Tar Creek. To determine whether the elevated heavy-metal concentrations and lowered pH of Tar Creek have had an effect on the surrounding plant communities and soils, samples of grass, sumac, and soil were collected in May 1984 at nine sites along Tar Creek, from above the mining area to its confluence with Neosho River. Major, minor, and selected trace elements of all vegetation samples were determined by inductively coupled plasma emission spectroscopy (ICP/ES). Analytical results for 24 elements are erratic and disappointing, and duplicate analyses of the same samples are not comparable. The high zinc concentrations in some of the samples might be either contaminating and/or interferring with the ICP/ES; therefore, the use of atomic-absorption spectrophotometry (AAS) might increase precision. Duplicate samples analyzed with AAS show greater precision than the same samples analyzed by ICP/ES; the zinc analyses by AAS for all samples are pending. When all zinc results are complete, As, Cd, Co, Cu, Pb, Ni, Mo, Fe, Mg, and Mn concentrations will also be determined by AAS. (See also W90-00022) (Lantz-PTT)
W90-00041

FIELD COMPARISON OF GROUND-WATER SAMPLING DEVICES FOR RECOVERY OF PURGEABLE ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 7B.
W90-00047

RECENT DEVELOPMENTS IN DOWNHOLE SAMPLERS FOR ORGANIC AND VOLATILE COMPOUNDS IN GROUND WATER.
Geological Survey, Stennis Space Center, MS.
For primary bibliographic entry see Field 7B.
W90-00048

SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN GROUND WATER BY GAS CHROMATOGRAPHY WITH PHOTOIONIZATION AND HALL DETECTORS.
Geological Survey, Trenton, NJ.
T. V. Fusillo, J. Gibs, J. A. Kammer, and T. E. Imbrigiotta.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p F9-F10.

Descriptors: Geochemistry, *Groundwater pollution, *Water analysis, *Measuring instruments, *Pollutant identification, *Volatile organic compounds, *Gas chromatography, Chemical analysis, Organic compounds, Mass spectrometry, Hall detectors, New Jersey Performance evaluation, Photoionization detectors, Maintenance, Detection limits, Water analysis, Aromatic compounds, Water sampling, Standards, Hydrologic data collections.

In 1984, new laboratory instrumentation was installed at the US Geological Survey's New Jersey District laboratory to scan water samples for volatile organic compounds (VOCs). The analytical procedure used is specified by the US EPA methods 601 (purgeable halocarbons) and 602 (purgeable aromatics). The instrumentation consists of five components: a Takmar model ALS automatic sampler, which sequentially sparges up to 10 samples; Tekmar model LSC-2 automatic purge and trap concentrator; Tracor model 540 gas chromatograph with Hall electrolytic conductivity detector and photoionization detector; 8-ft x 0.1-in. ID glass column packed with 1% SP-1000 on Carbopack B (60/80 mesh); and two Shimadzu model CR-3 computing integrators with a RS-232 computer interface. Since implementation of this scan, the New Jersey Laboratory has analyzed 367 samples for VOCs. The results can be summarized as follows: 282 samples (77%) contained no organic compounds at concentrations > background on the GC; of these, 18 were submitted for GC/MS confirmation, and all were confirmed to contain no detectable compounds. 37 samples (10%) contained at least 1 compound at a concentration > 0.5 microgram/L but no compounds > 3 microg/L; of these, 18 were submitted for GS/MS confirmation, and 177 were confirmed to contain no compounds at concentrations > 3 microg/L. 48 samples (13%) contained at least 1 compound > 3 microg/L. Of these, 25 were submitted for GC/MS confirmation, and 22 had at least 1 compound confirmed > 3 microg/L. Three problems have been identified in relation to the screening procedure. The first is the difficulty in completing the screening analysis in sufficient time to allow the submission of replicate samples for GC/MS analysis within the 14-day US EPA guideline. The second is the inability to store the GC scan data on WATSTORE. The third is equipment downtime, which has ranged from > 30% at startup to about 15% at present. (See also W90-00022) (Lantz-PTT)
W90-00049

APPLICATION OF THE GAS CHROMATOGRAPHIC/FLAME IONIZATION DETECTOR ANALYSIS.
Geological Survey, Reston, VA.
H. R. Feltz, J. A. Lewis, and F. L. Cardinali.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p F11-F15, 2 fig, 1 tab.

Descriptors: *Measuring instruments, *Gas chromatography, *Flame photometry, *Pollutant identification, *Water quality control, Monitoring, Organic compounds, Mass spectrometry, Nitrophenol, Naphthalene, Gasoline.

In an effort to reduce the cost of assessing the presence and concentration of organic substances in water and sediment, the US Geological Survey's National Water Quality Laboratory in Denver, CO., offers the gas chromatographic/flame ionization detector (GC/FID) analysis as a cost-effective and rapid screening procedure that complements the more expensive gas chromatographic/mass spectrometric (GC/MS) analysis for semivolatile organic compounds. The GC/FID analysis, or 'FID scan,' provides semiquantitative data that may be used in reconaissance or monitoring studies. Among the potential applications of the FID scan are: (1) screening a large number of samples from one or more sites for the presence of organic substances; (2) hydrocarbon 'fingerprinting,' where specific compounds such as nitrophenol, naphthalene, gasoline, or fuel oil may be a problem; or (3) as followup monitoring of specific organic compounds that have been identified by GC/MS analysis. (See also W90-00022) (Lantz-PTT)
W90-00050

EVALUATION OF FOUR FIELD-DETERMINED CHARACTERISTICS USED AS WATER-QUALITY INDICATORS DURING AQUIFER SAMPLING FOR PURGEABLE ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ.
J. Gibs, and T. E. Imbrigiotta.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p F19-F21, 1 fig, 1 tab.

Descriptors: *Pollutant identification, *Water analysis, *Sampling, *Water quality control, *Groundwater quality, *Organic compounds, Monitoring, Field tests, Hydrogen ion concentration, Dissolved oxygen, Water temperature, Ultraviolet radiation, Indicators, Performance evaluation, Water sampling, Aquifers.

A critical element of any groundwater sampling program is to ensure that the samples taken are representative. Tests were run at two wells to determine the best indicator for changes in purgeable organic compounds (POC) concentrations as the well casing is flushed. Field measurements of chloride ion, ultraviolet absorbance at 254 nm,

specific conductance, pH, dissolved oxygen, and water temperature were taken and compared. Temperature, DO and pH failed to follow the concentrations of POC well. However, specific conductance followed the trends of the POC concentrations at both wells, and chloride ion and ultraviolet absorbance followed the POC concentrations during the transient phase more closely than specific conductance; the ultraviolet absorbance followed the POC transient trends much more closely than the other field measurements at one well. Neither water temperature, pH, nor dissolved oxygen reflected the small fluctuations in POC concentrations during 10 hours of steady-state sampling. Ultraviolet absorbance followed the POC concentrations more closely than chloride ion where aromatic purgeable organic compounds were present, and chloride ion followed the POC concentrations more closely than specific conductance under steady-state conditions. Thus, no reliable general field indicator for POC concentration variability was found in this study. (See also W90-00022) (Lantz-PTT)
W90-00051

ATMOSPHERIC DEPOSITION; NORTH DAKOTA'S EXPERIENCE.
North Dakota State Dept. of Health, Bismarck. Div. of Hazardous Waste Management and Special Studies.
M. R. Deutschman.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 275-284, 1 fig, 4 tab, 4 ref.

Descriptors: *North Dakota, *Acid rain, *Path of pollutants, *Acid rain effects, *Pollutant identification, Nitrates, Air pollution, Water pollution effects, Monitoring, Hydrogen ion concentration, Aluminum, Iron, Zinc, Manganese, Nitrites, Sulfates.

The chemistry of wetfall and dryfall, and the associated air quality and surface meteorological conditions have been investigated in a systematic manner within North Dakota since August 1980. Coordinated by the North Dakota State Department of Health (NDSDH). The goals of the project were to determine the: (a) inorganic composition of wetfall and dryfall (dustfall); (b) important natural and anthropogenic influences on the chemical quality of regional deposition; and (c) possible spatial and temporal trends in deposition chemistry related to changes in land use, industrial activity, and meteorological conditions. Based on the 1980-1984 data from the Department's event-based monitoring sites, North DAkota wetfall is characterized by greater free acidity than generally reported for the northern plains. Quality assurance data, although based on a small sample size, indicated a decrease of 0.25 units for the mean pH of acid soaked buckets compared to water-rinsed buckets. The most abundant trace elements were aluminum, iron, zinc and manganese. Manganese and zinc were present primarily in the soluble fraction, while aluminum and iron were present primarily in the insoluble fraction. Agricultural activity had an important impact on wetfall chemistry in North Dakota. Data from the Department's monitoring sites indicate inverse relationships between the concentrations of alkaline earth metals (e.g., Ca, Mg) and pH, intimating their importance in neutralizing acidity. Monthly mean NH4(+) and NO3(-) concentrations peaked in July and August, the presumed periods of peak biological activity. The mean annual wet deposition of sulfate ranged from 3.3-3.9 kg/ha at three event-based sites. (See also W90-00063) (Lantz-PTT)
W90-00070

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME I.
Engineering-Science, Inc., Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199-484. Price codes: A99 in paper copy, A01 in microfiche. Final Report, July 1988. 672p, 75 fig, 42 tab, 10 append. USAF Contract F33615-84-D-4403.

Descriptors: *Military reservations, *Pollutant identification, *Data collections, *Path of pollutants, *Groundwater pollution, *Water pollution control, Water pollution sources, Aquifers, Florida, Monitoring, Geophysics, Permits.

An Installation Restoration Program (IRP) Phase II, Stage 2 investigation was conducted at MacDill AFB and Avon Park AFB, Florida, to confirm the presence or absence of contamination at twelve sites. Eight of the twelve sites were previously investigated under Phase II, Stage 1 efforts. Four sites had not previously been investigated under Phase II efforts. A field program was conducted, consisting of geophysical surveys, the drilling and installation of 28 monitoring wells, an aquifer pumping test in the surficial aquifer, and the collection and analysis of groundwater, surface water, and sediment samples. At MacDill AFB, no significant contaminants were found at two of the sites. These sites were recommended for no further action. At three other sites no significant contamination was found but other evidence suggested that additional study should be considered before specific action at these sites is recommended. Significant contamination was found at three sites and these sites were recommended for additional investigation. One site at MacDill AFB was recommended for remedial action. At Avon Park AFB, all three sites showed no significant contamination and were recommended for no further action. This volume presents these results and significant findings, along with 9 of the 10 accompanying appendices which present materials concerning: the personnel, boring logs, well forms and diagrams; aquifer test analysis; geophysical surveys; and analytical data reports. (See also W89-00133) (Lantz-PTT)
W90-00132

RECOMMENDATIONS FOR HOLDING TIMES OF ENVIRONMENTAL SAMPLES.
Oak Ridge National Lab., TN. Analytical Chemistry Div.
M. P. Maskarinec, L. H. Johnson, and S. K. Holladay.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011831. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-880768--2, (1988). 17p, 3 fig, 7 tab, 6 ref. EPA Contract 1824-1744-A1, DOA Contract 1769-1743-A1, and DOE Contract DE-AC05-84OR21400.

Descriptors: *Sample preservation, *Soil analysis, *Water analysis, *Pollutant identification, Pesticides, Volatile organic compounds, Sample preparation, Volatility, Chemical analysis.

Experiments have been conducted for the purpose of establishing acceptable minimum holding times for soil and water samples. Analytes of interest have been volatile organics, pesticides, and explosives. The pesticides and explosives represent subclasses of semivolatile organics. Several soils and several water samples have been used in this investigation. The holding times for volatile organics in water samples are dependent on the objectives of the analysis. Aromatics and some haloethanes are stable in water for limited times, approximately 14 days is the recommended maximum. However, the degradation of these compounds can be eliminated or greatly reduced by preservation with acid. Several acids are recommended, including HCl, ascorbic acid, and sodium hydrogen sulfate. Volatile organics in soil samples are much less stable, with the primary losses occurring through volatilization and microbial degradation. For these samples, rapid sample preparation (at least purging onto a sorbent trap) appears to be the only means of long term storage. Volatilization losses can be reduced by use of glass sample bottles with solid, teflon/foam caps and liners. Semivolatiles in water appear to degrade by both photochemical and microbial routes. Thus, the use of amber bottles and rapid addition of the extraction solvent are the best approaches to the maintenance of sample integrity. Even the least stable of the semivolatiles can be held for sufficient times to allow for shipment to the analytical facility with subsequent addition of the extraction solvent. (Lantz-PTT)
W90-00152

RADIOMETRIC DATING AND QUANTITATIVE ANALYSIS OF ELEMENTS IN DEPTH PROFILES OF SEDIMENTS BY MEANS OF NUCLEAR PHYSICAL AS WELL AS X-RAY FLUORESCENCE AND ATOMIC EMISSION SPECTROSCOPIC METHODS (RADIOMETRISCHE DATIERUNG UND QUANTITATIVE ELEMENTBESTIMMUNG IN SEDIMENTTLEFENPROFILEN MIT HILFE KERNPHYSIKALLSCHER SOWIE ROENTGENFLUORESZENZ UND ATOMEMISSIONSSPEKTROMETRISCHER VER-FAHREN).
Hamburg Univ. (Germany, F.R.). Fachbereich 12 - Physik.
M. Schonburg.
Available from National Technical Information Service, Springfield, VA 22161 as DE88-753791/GAR. Price codes: A06 in paper copy, A01 in microfiche. Report no. GKSS-87/E/54. 1987. 136p, 34 fig, 20 tab, 65 ref.

Descriptors: *Pollutant identification, *Radiochemical analysis, *Heavy metals, *Cores, *Radioactive dating, Lead radioisotopes, Cesium radioisotopes, Sediments, Water quality, Atomic emission spectrometry, X-ray fluorescence analysis.

The measurement of heavy metal concentration in sediments is of great importance for the assessment of water quality. If dating of the different layers of sediment cores is possible, information about the history of pollution can be inferred. This paper describes the development and practical test of a procedure suitable for the investigation of sediment cores. Both the element analysis and the dating are based on physical methods. For element concentration determination inductively coupled plasma atomic emission spectrometry (ICP), total-reflection X-ray fluorescence analysis (NAA) are used. The techniques are described and compared. For dating radiometric measurements of Pb210 and Cs137 are carried out with a coaxial well-type germanium gamm ray detector in a special low-level arrangement. Results of the systematic investigations are presented and a few individual depth profiles are discussed. (Author's abstract)
W90-00186

SPECIFIC CONDUCTANCE: THEORETICAL CONSIDERATIONS AND APPLICATION TO ANALYTICAL QUALITY CONTROL.
For primary bibliographic entry see Field 7B.
W90-00217

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 2. VOLUME I: LUKE AIR FORCE BASE, ARIZONA.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5B.
W90-00234

TRACE SUBSTANCES PRESENT AS CHLORINATION BY-PRODUCTS IN DRINKING AND PROCESS WATERS.
Oak Ridge National Lab., TN. Waste Management Technology Center.
For primary bibliographic entry see Field 5F.
W90-00242

ROLE OF HEALTH-BASED CRITERIA DEVELOPMENT IN USATHAMA'S INSTALLATION RESTORATION PROGRAM.
Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W90-00243

CHROMATOGRAPHY FOR WATER POLLUTION ANALYSIS, JANUARY, 1977-OCTOBER, 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-870365,

Price codes: N01 in paper copy, N01 in microfiche. October 1988. 179p. Supercedes PB88-873619.

Descriptors: *Water analysis, *Bibliographies, *Chromatography, *Pollutant identification, Oil spills, Industrial wastewater, Muncipal wastewater, Water pollution effects, Drinking water, Groundwater pollution, Lakes, Rivers, Seawater.

This bibliography contains 324 citations concerning chromatographic analysis of water pollutants; 129 citations are new entries to the previous edition. Chromatographic determination, source identification, and characterization of pollutants generated by oil spills, industrial processes, and municipal wastes are discussed. Water pollution effects on aquatic ecosystems and pollutants in drinking water; groundwater; and lake, sea, and river water are evaluated and analyzed. (Author's abstract)
W90-00256

MONITORING OF THE SEA: REPORT ON THE ACTIVITIES IN 1984 (UEBERWACHUNG DES MEERES: BERICHT FUER DAS JAHR 1984).
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81994/GAR. Price codes: E07 in paper copy, A01 in microfiche. January 1986. 32p, 41 fig, 19 tab, 23 ref. English summary.

Descriptors: *Monitoring, *International agreements, *International waters, *North Sea, *Baltic Sea, Chemical analysis, Hydrocarbons, Heavy metals, Oxygen, Petroleum hydrocarbons, Flow, Temperature, Salinity, Radioactivity, Tides, Legal aspects.

In conjunction with collaboration with foreign authorities in the monitoring of the observance of international agreements for protecting the sea environment, measurements were carried out by the German Hydrographic Institute, particularly in the North Sea and the Baltic. Analyses included food and oxygen contents, heavy metal loadings, and the extent and concentrations of halogenated hydrocarbons and petroleum hydrocarbons. Radioactivity, contamination of the bottom of the sea and suspended matter were also monitored, as were flow, temperature, salt contents, tides and mixing and layering processes in seawater. The use of aircraft and satellites for photography of sea contamination, and legal regulations to protect the sea against contamination are briefly described. The results of investigations for the year 1984 are presented. (Author's abstract)
W90-00263

MONITORING OF THE SEA: REPORT ON THE ACTIVITIES IN 1983 (UEBERWACHUNG DES MEERES: BERICHT FUER DAS JAHR 1983).
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81993/GAR. Price codes: E07 in paper copy, A01 in microfiche. September 1984. 30p, 57 fig, 23 ref. English summary.

Descriptors: *Monitoring, *International agreements, *International waters, *North Sea, *Baltic Sea, Chemical analysis, Hydrocarbons, Heavy metals, Oxygen, Petroleum hydrocarbons, Flow, Temperature, Salinity, Radioactivity, Tides, Legal aspects.

In the context of collaboration with foreign authorities in monitoring the observance of international agreements on the protection of the sea environment, the German Hydrographic Institute has carried out measurements, particularly for the North Sea and the Baltic. These concern the food and oxygen contents, the loading with heavy metals and the concentrations of halogenated hydrocarbons and petroleum hydrocarbons. Radioactivity, contamination of the bottom of the sea, are also monitored, as are flow, temperature, salt content, tides and layering/mixing processes in seawater. The results of investigations for the year 1983 are introduced. There are brief reports on the possible use of aircraft and satellites for monitoring contamination of the sea and on the most important legal regulations to protect the sea against contamination. (Author's abstract)
W90-00264

TOXIC EFFECTS OF METALS ON FISH: EVALUATION OF PHYSIOLOGICAL TEST METHODS (TOXISKA EFFECKTER AV METALLER PA FISK: PROVNING AV FYSIOLOGISK TESTMETDIK).
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
For primary bibliographic entry see Field 5C.
W90-00271

HEAVY METAL CONCENTRATIONS IN THE MEDITERRANEAN ESTUARINE REGIONS OF THE RHONE, EBRO, PO, AND ARNO RIVERS (ERMITTLUNG DER AKTUELLEN SCHWERMETALLBELASTUNGEN IN DEN MITTELMEERASESTUARIEN VON RHONE, EBRO, PO UND ARNO).
Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet.
For primary bibliographic entry see Field 5B.
W90-00273

DETERMINATION OF FLUORIDE IONS IN WATER BY CONDUCTOMETRIC TITRATION WITH LANTHANUM NITRATES (DETERMINACAO DE IONS FLUORETO EM AGUAS, POR TITULACAO CONDUTOMETRICA COM NITRATO DE LANTANIO).
Sao Paulo Univ. (Brazil). Inst. de Quimica.
J. C. Alves.
Available from National Technical Information Service, Springfield, VA 22161 as DE88702319/GAR. Price codes: A05 in paper copy, A01 in microfiche. INIS-BR-1055, 1986. 96p, 16 fig, 8 tab, 145 ref. English summary.

Descriptors: *Water analysis, *Fluoride, *Chemical analysis, *Drinking water, Titration, Sulfuric acid, Conductometric titration.

Fluoride ions in drinking water can be easily determined by conductometric titration using La(NO3)sub 3 as titrant. The sample must be distilled in H2SO4 previously to separate the fluoride ions, at 135 C. The distillate, in 50% ethanol, is titrated with La(NO3)sub 3. In these conditions, fluoride ions at the concentrations of 500 ppb and 2.0 ppm are determined with accuracy of, respectively, 5% and 4%. Natural samples of drinking water were analyzed by this method and by the ion selective method with good agreement among the results. (Author' abstract)
W90-00274

MICRODETERMINATION OF TRACE COBALT IN WATER BY DIRECT POLYURETHANE FROM THIN-LAYER SPECTROPHOTOMETRY.
M. N. Abbas, N. B. El-Assy, and S. Abdel-Moniem.
Analytical Letters ANALBP, Vol. 22, No. 6, p 1555-1565, June 1989. 4 fig, 1 tab, 16 ref.

Descriptors: *Water analysis, *Chemical analysis, *Spectrophotometry, *Cobalt, *Pollutant identification, Quantitative analysis, Separation techniques.

Traces of cobalt in water sample are preconcentrated into a white thin-layer of a parallelpiped polyurethane foam by the sorption of its thiocyanate complex from acidic medium. The cobalt thiocyanate complex possesses a blue color in the foam matrix which has a maximum absorption at 625 nm. The absorbence of the blue species is measured directly in the foam matrix at 680, 625 and 540 nm. With different media in the measuring cell. The net absorbance of 625 nm is calculated using a multiwavelength program, where the value of the blank is subtracted. Beer's law is obeyed in the concentration range 0.025-2.0 microgram/dl with a detection limit of 25 microgram/dl for a 100 ml sample volume. The method is specific for cobalt. (Author's abstract)
W90-00294

DETERMINATION OF NITRITE BY SINGLE-SWEEP POLAROGRAPHY.
Central China Normal Univ., Wuhan. Dept. of Chemistry.
L. Guanghan, and Y. Shenglai.
Analytical Letters ANALBP, Vol. 22, No. 7, p 1743-1751, 1989. 4 fig, 1 tab, 7 ref.

Descriptors: *Nitrites, *Polarographic analysis, *Pollutant identification, *Water analysis, Quantitative analysis, Chemical analysis, Separation techniques.

A new method for determining nitrite is proposed. The mechanism for the polarographic waves and the condition for determining nitrite are discussed in this paper. In cathodic sweeps, the peak height is directly proportional to the concentration of nitrite over the range of 5 times 10 to the minus 9 to 6 times 10 to the minus 7 g/ml. The detection limit is 4 times 10 to the minus g/ml. The experiments showed that this polarographic wave is an adsorption wave, and useful in determination of nitrite in water sample. (Author's abstract)
W90-00297

SEMIQUANTITATIVE AND QUANTITATIVE DETERMINATION OF TRACE AMOUNT OF PHOSPHATE ION IN WATER USING POLYURETHANE FOAM THIN-LAYER COLORIMETRY.
Mansoura Univ. (Egypt). Dept. of Chemistry.
B. Farag, M. N. Assas, N. B. Al-Assy, and H. E. El Din.
Analytical Letters ANALBP, Vol. 22, No. 7, p 1765-1777, 1989. 3 fig, 2 tab, 13 ref.

Descriptors: *Water analysis, *Chemical analysis, *Phosphates, *Colorimetry, *Pollutant identification, Quantitative analysis, Separation techniques.

A simple, sensitive and fast method for the colorimetric determination of phosphate ion in water is described. The method is based on spectrophotometric measurement of the blue molybdoantimony phosphoric acid species sorbed in a polyurethane foam thin-layer for quantitative determination of phosphate ion, or the visual color comparison technique for rapid semiquantitative determination. The detection limit for the quantitative procedure is 5 microgram/l and for semiquantitative procedure 20 microgram/l for sample volumes of 10 ml and 25 ml, respectively. The present work describes the possible application of polyurethane foam thin-layer for the direct visual or spectrophotometric determination of phosphate ion in natural water samples. The method is shown to be capable of detecting and quantitatively determining low concentrations of phosphate ion in a variety of water samples. (Author's abstract)
W90-00298

SIMULTANEOUS EXTRACTION AND ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF 1B GROUP ELEMENTS (CU, AG, AU) FROM AQUEOUS THIOCYANATE/2,2-DIPYRIDYL-2-PYRIDYLHYDRAZONE (DPPH) SOLUTIONS.
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
For primary bibliographic entry see Field 7B.
W90-00299

EXTRACTION, SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM WITH CAFFEIC ACID AND APPLICATION IN HIGH PURITY GRADE STEEL AND ENVIRONMENTAL SAMPLES.
Baroda Univ. (India). Dept. of Pharmacy.
For primary bibliographic entry see Field 7B.
W90-00300

CURRENT APPROACHES TO DEVELOPING SEDIMENT QUALITY CRITERIA.
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 589-599, 1989. 1 fig, 1 tab, 29 ref.

Descriptors: *Environmental quality, *Standards, *Pollutant identification, *Sediments, *Research priorities, Water quality, Sediment-water interfaces, Bioassay.

Current approaches to developing sediment quality criteria are reviewed and separated into two major groups: Those approaches that provide only chemical-by-chemical criteria and those that provide criteria for chemical mixtures also. The individual approaches include background sediment chemistry, water quality criteria, sediment/water equilibrium partitioning, sediment bioassay, screening level concentration, apparent effects threshold and sediment quality triad. Based on the evaluation of the two groups and seven individual approaches, it is concluded that, for chemical-by-chemical criteria, the equilibrium partitioning method shows promise; for criteria that are also applicable to chemical mixtures, the apparent effects threshold/sediment quality triad approaches appear to be most appropriate. Recommendations are made concerning specific immediate research needs, related to developing effective, usable sediment quality criteria. (Author's abstract)
W90-00311

CLOUDWATER CHEMISTRY IN SEQUOIA NATIONAL PARK.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2B.
W90-00345

EVALUATION OF MEDIA FOR MONITORING FECAL STREPTOCOCCI IN SEAWATER.
A. Felix Public Health Lab., Tel-Aviv (Israel). Y. Yoshpe-Purer.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 2041-2045, August 1989. 7 tab, 21 ref.

Descriptors: *Monitoring, *Bioindicators, *Culture media, *Enteric bacteria, *Growth media, *Fecal streptococci, *Bacterial analysis, Water pollution, Seawater, Agars, Mediterranean Sea.

The selectivity of KF streptococcus agar (KF) for monitoring fecal streptococci (FS) in seawater was examined in 234 samples of Mediterranean water and compared with the selectivity of M-Enterococcus agar (M-Ent) for 124 samples and with bile-esculin-azide agar (BEA) for 17 samples. KF was found to be unsuitable for marine water because Vibrio alginolyticus and other gram-negative bacilli indigenous to this environment grew well on it and produced red colonies identical to those of FS. In 26% of samples, some with high counts of red colonies on the membrane filters (MF), there were no streptococci, only gram-negative bacilli and staphylococci, and in an additional 23.1% the streptococci constituted less than 50% of the 'typical' red colonies on the MF. V. alginolyticus also produced FS-like colonies on MF incubated on BEA but was not isolated from MF incubated on M-Ent. Although staphylococci grew and produced FS-like colonies on all three media, M-Ent was the most selective since no gram-negative bacilli were isolated from MF incubated on it. (Author's abstract)
W90-00395

ELECTRODE SYSTEM FOR DETERMINATION OF MICROBIAL CELL POPULATIONS IN POLLUTED WATER.
Nanjing Inst. of Technology (China). Dept. of Applied Chemistry.
Y. Maoyu, and Y. Zhang.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 2082-2085, August 1989. 9 fig, 9 ref.

Descriptors: *Bacterial analysis, *Water pollution, *Electrodes, Escherichia coli, Pseudomonas.

Microbial cell populations in polluted water were determined by using a fuel cell-type electrode. The electrode was composed of a Pt anode, a Pt-K3Fe(CN)6-K4Fe(CN)6 cathode, and a cation-exchange membrane for separating two electrode compartments. The principle of microbial cell number determination is based on sensing a redox dye reduced by microorganisms with the electrode. Sample solutions containing microorganisms (Escherichia coli, Pseudomonas), a redox dye (thionine), and peptone were purged with oxygen-free nitrogen during the determination. A linear relationship was obtained between the increasing rate of current and the number of microbial cells measured by the colony count method above 10,000 cells/ml. The determination time varied with the number of microbial cells determined from 20-60 min for 3,600,000 and 36,000 cells/ml, respectively. (Author's abstract)
W90-00397

DETERMINATION OF TOTAL SULFUR IN FRESHWATER SEDIMENTS BY ION CHROMATOGRAPHY.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
C. A. Hordijk, J. J. M. Van Engelen, F. A. Jonker, and T. E. Cappenberg.
Water Research WATRAG, Vol. 23, No. 7, p 853-859, July 1989. 2 fig, 2 tab, 34 ref.

Descriptors: *Lake sediments, *Chemical analysis, *Sulfur, *Ion exchange, *Chromatography, Lake Vechten, The Netherlands.

A method to determine total S in freshwater sediments was developed. This method involves oxidation of the sediment by a half fusion reaction with a Na2CO3/KNO3 mixture, purification with cation exchange chromatography and detection of the released sulfate by indirect photometric chromatography. Total S estimates from the sediment of Lake Vechten were similar to those obtained by induced coupled plasma chromatography with roentgen-fluorescence spectrometry. The method gives reliable results with difficult-to-oxidize R-S-R bonds such as those in methionine. The detection of sulfate by the sensitive technique of ion-chromatography (detection limit 5 pmol) enables S analysis in microgram quantities. The method can be combined with trace determinations of radioactive S-32. Total S in the 47-year old sediment of Lake Vechten varied between 1100-1600 mg/l wet sediment, representing approximately 0.4% of the dry weight. The total S pool is comprised of 3% elemental S, 8% pyrite, 60% acid soluble volatile sulfide and 12% ester sulfates, leaving 17% non-identified. From a comparison of total S estimates in the 28 cm thick sedimented layer (125 g S/sq m), sulfate reduction rates (11.4 g S/sq m/yr) and sedimentation rates (3.21 g S/sq m/day), it appears that most of the S reduced during the year is re-oxidized. (Author's abstract)
W90-00418

SIMPLE BIOASSAY WITH ARTEMIA LARVAE TO DETERMINE THE ACUTE TOXICITY OF ANTIFOULING PAINTS.
Ghent Rijksuniversiteit (Belgium). Lab. for Biological Research in Aquatic Pollution.
G. Persoone, and J. Castritsi-Catharios.
Water Research WATRAG, Vol. 23, No. 7, p 893-897, July 1989. 5 tab, 8 ref.

Descriptors: *Pesticides, *Bioindicators, *Toxicity, *Bioassay, *Water pollution, *Antifoulants, Brine shrimp, Shrimp.

The toxic effects on mollusk cultures of chemicals leaching from coatings on ship hulls of pleasure craft has triggered substantial research on the hazard of antifouling paints for non-target biota. Conventional laboratory bioassays are mostly carried out on individual (pure) toxicants incorporated in such paints and thus do not simulate the leaching of the toxic compounds from the antifouling coatings. In order to simulate such conditions, an attempt was made to determine the toxicity of coated test panels to nauplii of the brine shrimp Artemia as test species. The surface-to-volume ratio (S/V = coated surface of test panel to volume of seawater in the test vessel) was used a criterion for determination of the S/V-LC50, which may be a useful approach for toxicity ranking of antifouling paints. The influence of several variables (time of exposure, turbulence of the medium and leaching time prior to Artemia exposure) has been considered, and each of the factors analysed seemed to have at least some influence. On the basis of the results obtained, it seems that a promising new standards bioassay method to test the toxicity of coated surface, based on the use of Artemia nauplii as convenient test organisms, may be worked out in the near future. (Author's abstract)
W90-00423

NOVEL METHOD FOR THE DETECTION AND SEMIQUANTITATIVE DETERMINATION OF TRACE LEVELS OF 2,4-D AND RELATED COMPOUNDS.
Aligarh Muslim Univ. (India). Dept. of Applied Chemistry.
H. S. Rathore, and H. A. Khan.
Water Research WATRAG, Vol. 23, No. 7, p 899-905, July 1989. 1 fig, 4 tab, 12 ref.

Descriptors: *Pollutant identification, *Water analysis, *Herbicides, *Water pollution, *Chemical analysis, Soils, Leaves, Trace levels, Phenoxy acid herbicides.

A sensitive and selective novel technique was developed for the detection and semiquantitative determination of phenoxy herbicides. The herbicide is heated in the presence of hydrated zinc sulfate to split off formaldehyde. The pressure is reduced in order to bubble the formaldehyde vapors into the reagent (one or two tiny crystals of chromotropic acid sodium salt in 0.20 ml of concentrated sulfuric acid). This technique was used successfully for the detection of traces of 2,4-D and 2,4-D ethyl ester and 2,4-D sodium salt in formulations, leaves, soil and water. (Author's abstract)
W90-00424

EFFECT OF CULTURE MEDIUM ON METAL TOXICITY TO THE MARINE DIATOM NITZSCHIA CLOSTERIUM AND THE FRESHWATER GREEN ALGA CHLORELLA PYRENOIDOSA.
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Analytical Chemistry Section.
J. L. Stauber, and T. M. Florence.
Water Research WATRAG, Vol. 23, No. 7, p 907-911, July 1989. 7 tab, 32 ref.

Descriptors: *Culturing techniques, *Pollutant identification, *Heavy metals, *Toxicity, *Diatoms, *Chlorophyta, *Bioassay, *Copper, *Zinc, *Lead, Nitzschia, Chlorella, Culture media, Chelating agents.

The composition of the culture medium and its effects on the toxicity of ionic Cu and Zn to the marine diatom Nitzschia closterium and the toxicity of Cu and Pb to the freshwater green alga Chlorella pyrenoidosa were examined. The inhibitory concentration of Cu giving 50% reduction in cell division rate in C. pyrenoidosa increased from 16 microgram Cu/l in synthetic softwater and 24 microgram Cu/l in EPA-AAP medium (minus EDTA) to >200 microgram Cu/l in high nutrient MBL medium. Similarly, marine medium f reduced Cu and Zn toxicity to N. closterium 10-20 fold compared to seawater. To overcome the problems of metal complexation by chelators such as silicate, iron and EDTA in the assay medium, unsupplemented seawater and buffered synthetic softwater, enriched only with nitrate and phosphate, were used for the study of metal toxicities to marine and freshwater algae. These low nutrient media are sufficient to support algal growth over the 4-day assay period. (Author's abstract)
W90-00425

SELECTIVE AND SENSITIVE SPECTROPHOTOMETRIC DETERMINATION OF COPPER IN WATER AFTER COLLECTION OF ITS BATHOCUPROINE COMPLEX ON AN ORGANIC-SOLVENT-SOLUBLE MEMBRANE FILTER.
Toyama Univ. (Japan). Faculty of Science.
I. Kasahara, T. Ogawa, N. Hata, S. Taguchi, and K. Goto.
Water Research WATRAG, Vol. 23, No. 7, p 933-936, July 1989. 1 fig, 4 tab, 12 ref.

Descriptors: *Copper, *Heavy metals, *Chemical analysis, *Water analysis, *Pollutant identification, *Spectrophotometry, Metal complexes, Membrane filtration.

A rapid and simple preconcentration technique which can be used in place of solvent extraction was applied to the spectrophotometric determination of copper in water. Copper(II) is reduced to copper(I) by hydroxylammonium chloride and complexed with Bathocuproine (2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline). The Bathocuproine complex is collected on a nitrocellulose membrane filter by passing the solution through the filter. The membrane filter and the complex are dissolved in a small volume of 2-methoxyethanol (Methylcellosolve) and the absorbance due to the complex in the solvent is measured at 477 nm. The proposed method is nearly specific to copper. It is less tedious than the conventional solvent extraction method and can be used by inexperienced workers. Enrichment factors as high as 100 can be easily attained, so that microgram/l levels of copper in water can be determined precisely without using expensive apparatus such as a furnace atomic absorption spectrometer. The detection limit is 0.12 microgram in 500 ml sample. (Author's abstract)
W90-00428

QUANTITATIVE DETERMINATION OF VOLATILE ORGANOCHLORINE COMPOUNDS IN WATER BY GC - HEADSPACE ANALYSIS WITH DIBROMOETHANE AS AN INTERNAL STANDARD.
Leiden Rijksuniversiteit (Netherlands). Center for Chemistry and the Environment.
D. Hersfeld, K. D. vanderGun, and R. Louw.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1425-1430, 1989. 2 fig, 5 tab, 3 ref.

Descriptors: *Water analysis, *Chlorinated hydrocarbons, *Pollutant identification, *Chromatography, Surfactants, Salts, Quantitative analysis, Standards, Headspace gas chromatography, Dibromoethane, Carbon tetrachloride,.

Concentrations of carbon tetrachloride (> 0.05 ppb) in water were determined in parallel with static headspace gas chromatography using dibromomethane as an internal standard (IS). The applicability of the method was investigated in matrices containing salt and surfactant. The use of an IS in analysis of real waters shows distinct advantages compared to an external calibration; scattering is much smaller in IS calibration, which can be due to variable injection volumes as well as to day to day's temperature fluctuations during the one month period of analysis. Although the IS (CH2Br2) can not compensate for all matrices, such as 335 mg CTAB/L, its use is important in recognizing water qualities which strongly influence Henry's constant, leading to uncertain results. It has been shown that the influence of the matrix parallels Henry's constants for the respective contaminants. Therefore, the IS would stand only for a compromise in getting true results. Nevertheless, comparison of IS peak areas from pure water with those from river water samples shows that 'real' river water is not of the same composition as the artificially prepared matrices. Consequently, using CH2Br2 as IS holds as a handy routine method for the analysis of river water. (Miller-PTT)
W90-00438

APPLICATION OF HEADSPACE ANALYSIS AND AOX-MEASUREMENT TO LEACHATE FROM HAZARDOUS WASTE LANDFILLS.
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.).
C. Foerst, L. Stieglitz, W. Roth, and S. Kuhnmuench.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1943-1954, 1989. 1 fig, 10 tab, 9 ref.

Descriptors: *Quantitative analysis, *Organic compounds, *Leachates, *Wastewater analysis, *Water analysis, *Hazardous wastes, *Landfills, *Pollutant identification, Waste disposal, Chlorine.

The applicability of headspace analysis for the quantitation of volatile organic compounds in leachates from hazardous waste landfills is investigated with respect to standard stability, leachate stability and reproducibility. Between the corresponding data sets, deviations at about 10% are observed. Besides the analysis of the volatile leachate components, the sum parameters of purgeable organic halogen (POX) and adsorbable organic halogen (AOX) are determined for the leachate samples. From the POX-data, good agreements with the total organic chlorine determined by headspace analysis are received. For determination of AOX, two different methods are applied to the leachates. Method A involves shaking of the sample with activated charcoal, after removal and separate determination of POX. Method B applies the samples to a system of two microcolumns, each filled with 40 mg of activated charcoal. Results with the different methods are discussed with respect to the high concentrations of POX determined in all leachate samples. (Geiger-PTT)
W90-00479

EVALUATION OF THE TOXICITY OF MARINE SEDIMENTS AND DREDGE SPOILS WITH THE MICROTOX BIOASSAY.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W90-00486

EFFECT OF SMALL CHANGES IN INCUBATION TEMPERATURE ON THE FIVE DAY BIOCHEMICAL OXYGEN DEMAND TEST.
Trinity Coll., Dublin (Ireland).
N. F. Gray.
Environmental Technology Letters ETLEDB, Vol. 10, No. 3, p 253-258, March 1989. 4 tab, 9 ref.

Descriptors: *Water analysis, *Wastewater analysis, *Biochemical oxygen demand, *Water temperature, *Testing procedures, Oxygen, Water quality, Wastewater treatment, Water treatment.

The effect of incubation temperature variations on the outcome of biochemical oxygen demand (BOD) test results was examined using an oxygen electrode and meter according to the British standard method. A stock solution of OECD/EEC synthetic sewage was used and diluted to give an expected BOD of approximately 140 milligrams O2/liter using a 1 in 49 test dilution. The samples were seeded using Bioseed, a manufactured dehydrated microbial culture, which has been shown to produce precise and repeatable BOD results. Six replicate BOD bottles were incubated for 5 days in water baths, where the temperature variation was less than +or-0.2 C, at 18, 19, 20, 21 and 22 C, using the same batch of synthetic sewage and seed. Six replicates were incubated at each of the five test temperatures. The BOD concentration of the test material increased with incubation temperature over the experimental range. Comparing the mean values at each temperature, the expected BOD was reduced by 10.3 and 5.3% at 18 and 19 C, respectively, and increased by 5.0 and 11.4% at 21 and 22 C, respectively compared to the normal incubation temperature of 20 C. Using all the data, it was calculated that each 1 C change in temperature resulted in an approximate 5% change in BOD concentration over the 4 C test range. (Geiger-PTT)
W90-00487

BOD INCUBATORS AND TEMPERATURE VARIABILITY.
Trinity Coll., Dublin (Ireland).
N. F. Gray.
Environmental technology Letters ETLEDB, Vol. 10, No. 3, p 259-268, March 1989. 3 fig, 3 tab, 3 ref.

Descriptors: *Water analysis, *Wastewater analysis, *Biochemical oxygen demand, *Water temperature, *Testing procedures, Water quality, Oxygen, Water treatment, Wastewater treatment, Incubation.

Small variations in incubation temperature can significantly affect the final biochemical oxygen demand (BOD) result. Thirteen incubators were examined by their operators and found to display wide variations in temperature. Only three were able to conform to the standard incubation temperature and limits of 20 +or-0.5 C. Temperature variation in the incubators tested varied from 0.3 to 3.0 C. Temperature uniformity within a single incubator was studied using a matrix of thermocouples. While the temperature within individual BOD bottles remained reasonably constant over a 24 hr period (0.2-0.6 C), the mean bottle temperature varied from 18.7 to 20.9 C depending on the position within the incubator. Other factors such as stocking density and opening the incubator door are also considered. To ensure minimum deviation from the recommended incubation temperature of 20 +or-0.5 C incubators should be regularly calibrated for temperature and be kept in areas that experience little fluctuation in temperature. (Author's abstract)
W90-00488

EVALUATION OF THE ABILITY OF EXTRACTANTS TO RELEASE HEAVY METALS FROM ALGA AND MOLLUSC SAMPLES USING A SEQUENTIAL EXTRACTION PROCEDURE.
Bristol Univ. (England). Dept. of Inorganic Chemistry.
C. P. Jordao, and G. Nickless.
Environmental Technology Letters ETLEDB, Vol. 10, No. 4, p 445-451, April 1989. 4 tab, 22 ref.

Descriptors: *Chemical analysis, *Pollutants, *Pollutant identification, *Algae, *Mollusks, *Heavy metals, *Separation techniques, *Bioaccumulation, Zinc, Cadmium, Lead, Copper, Solvents, Acids.

An analytical procedure involving sequential chemical extractions was applied for the evaluation of the ability of different extractants to release Zn, Cd, Pb, and Cu from aquatic plants and animals. Seaweed (Fucus vesiculosus and Fucus serratus), limpets (Patella vulgata), and winkles (Littorina littoralis) were collected at St. Thomas Head and were prepared for extraction. The sequential acid extraction was: MgCl2 fraction; NaOAc fraction; NH2OH.HCl/HOAc fraction; H2O2/NH4OAc fraction; and HF/HNO3 fraction. The heavy metals studied were more strongly concentrated in the soft tissues than in the skeleton of the mollusks. The reagents employed in the sequential extraction procedure recovered different amounts of the metals from these samples, suggesting variations on the type of bonding as well as on the strength of the extractants. The majority of the metals appeared to be associated with the small organic fraction with some being attached to the carbonate phase. Cu showed a tendency to be recovered by the two strongest extractants, mainly the organic and residual phases. The relatively high Cu levels in F. vesiculosus were extracted with hydrogen peroxide. Very small changes in the levels of Cd in F. vesiculosus were found when extracted by MgCl2, NH2OH.HClHOAc, H2O2/NH4OAc or HF/HNO3. NaOAc extracted most of the Cd and Zn while Pb and Cu were not detectable in this phase. Both H2O2/NH4OAc and NH2OH.HCl/HOAc extracted proportionately the largest amounts of Zn and Cd, respectively from F. serratus. (Geiger-PTT)
W90-00498

MICROORGANISMS: INDICATORS OF POLLUTION IN INTEGRATED LIVESTOCK-FISH FARMING SYSTEMS.
Central Luzon State Univ., Munoz (Philippines).
O. D. Quines.
Environment International, Vol. 14, No. 6, p 531-534, 1989. 4 tab, 33 ref.

Descriptors: *Water pollution sources, *Bioindicators, *Microorganisms, *Bioindicators, *Fish ponds, *Fish farming, Tilapia, Carp, Salmonella, Coliforms, Manure.

Twelve fishponds each measuring 1,000 sq m stocked with 2,000 fish consisting of 85% Oreochromis niloticus, 14% Cyprinus carpio, and 1% Ophicephalus striatus were used to determine the level of fecal coliforms in the pondwater and fish flesh and the presence of Salmonella in the pondwater. Water samples for coliforms were collected at weekly intervals while those for Salmonella were done biweekly from three pond sites at a points spaced out from a manure dumping site. Fish were randomly sampled by seining the pond over a three-month period. Both water and fish samples were analyzed for coliforms with the multiple-tube fermentation technique and for Salmonella using the swab technique. Results showed coliform counts with mean concentrations varying form 29,700/L of water in the middle of the pond to 18,100/L farthest from the manure dumping site. Differences in concentrations between collection sites were not significant ($P > 0.05$) but mean values obtained weekly differed significantly ($P < 0.05$). Tilapia had coliform counts of 1.7/g flesh while carp had 1.1/g flesh. Differences among fish samples of the same species were not significant ($P < 0.05$). Biochemical tests revealed the presence of E. coli and Klebsiella sp. and more commonly S. cholerasuis. These findings suggest that measures should be adopted to sterilize the pig manure to kill the microorganisms prior to loading it in and integrated pond. (Author's abstract)
W90-00514

OZONATION BYPRODUCTS: IMPROVEMENT OF AN AQUEOUS-PHASE DERIVATIZATION METHOD FOR THE DETECTION OF FORMALDEHYDE AND OTHER CARBONYL COMPOUNDS FORMED BY THE OZONATION OF DRINKING WATER.
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5F.
W90-00537

ACID DIGESTION FOR SEDIMENTS, SLUDGES, SOILS, AND SOLID WASTES. A PROPOSED ALTERNATIVE TO EPA SW 846 METHOD 3050.
California Dept. of Health Services, Los Angeles. Southern California Lab.
D. E. Kimbrough, and J. R. Waskakuwa.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 898-900, July 1989. 4 tab, 6 ref.

Descriptors: *Pollutant identification, *Laboratory methods, *Antimony, *Silver, *Heavy metals, *Chemical analysis, Acid digestion, Sediments, Sludge, Soil types, Solid wastes, Analytical methods.

EPA SW 846 3050 does not reproducibly recover either antimony or silver from soil or sludge samples. Both of these elements are regulated by Federal and California state law, necessitating that these elements be included in the routine scans for toxic metals. A method has been developed that will provide data for these elements that meets EPA mandated quality control requirements. The matrix is digested with a 4:1 nitric acid-hydrochloric acid mixture and brought to near dryness. The digestate is washed in a solution of 1% nitric acid-1% hydrochloric acid and filtered through filter paper that is washed with hot concentrated hydrochloric acid followed by deionized water. The filter paper and residue are refluxed in 5 ml of concentrated hydrochloric acid and filtered. The two filtrates are analyzed by either ICP or FAA. Advantages of this technique include the range of elements recovered, precision, accuracy and the ease of use. (Author's abstract)
W90-00541

ANALYTICAL CHEMISTRY FOR ENVIRONMENTAL SCIENCES.
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. F. D'Elia, J. G. Sanders, and D. G. Capone.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 768-774, July 1989. 3 fig, 2 tab, 30 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Monitoring, *Water chemistry, *Baseline studies, Standard methods, Sample contamination, Laboratory methods, Instrumentation, Sampling techniques, Chesapeake Bay.

Data obtained in many monitoring studies are typically so compromised in one or more respects that they are of little value. This situation occurs despite the expenditure of enormous sums of money on environmental monitoring programs and despite the development of comprehensive quality assurance/quality control plans. Drawing heavily on experiences with monitoring in Chesapeake Bay, common analytical problems associated with monitoring programs for natural water included: sample contamination, difficult and tedious analysis, improper sample preparation and preservation, improper sampling, improper standardization, incorrect reporting of analytical statistics, no satisfactory method available for chosen analyte, poor technique, right method-wrong sensitivity range, sample matrix problems, uncalibrated or inadequate instrumentation, wrong chemical form determined, and wrong method. Recommendations for improving monitoring include: review of standard EPA methods in the context of the concentrations of analytes encountered in natural waters; establish national system of regional centers of expertise; increase research into new methods; abolish the practice of reporting analytical measurements as nondetects; and improve quality assurance/quality control plans to address specific objectives and provide the rationale for making the measurement. (White-Reimer-PTT)
W90-00542

CHARACTERIZATION OF PHOSPHORUS IN SLUDGE EXTRACTS USING PHOSPHORUS-31 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
Z. R. Hinedi, A. C. Chang, and R. W. K. Lee.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 323-329, Jul-Sep 1989. 12 fig, 3 tab, 31 ref. NSF grants CHE-82-03497 and DMB 860 4091, DOE grants FG 03-86 and FRI 3535, and NIH Public Health Service grant BR2G2507.

Descriptors: *Wastewater treatment, *Phosphorus, *Sludge, *Sludge digestion, Anaerobic digestion, Aerobic digestion, Phospholipids, Monoesters, Diesters, Dialysis, Extraction techniques.

Nuclear magnetic resonance spectroscopy was used to characterize the phosphorus (P) extracted from selected municipal sewage sludges. Aqueous and nonaqueous extraction schemes were studied. The trichloroacetic acid/KOH two-step extraction and the 0.5M NaOH extraction were effective in recovering P from sludges. It was found that the P distribution pattern in sludges was affected by the sludge digestion processes. Almost all of the P in anaerobically digested sludges was inorganic. In the waste-activated sludge and aerobically digested sludges, more than 50% of the total P was present as P-monoesters and P-diesters. Several experiments were conducted to confirm P-diester peak assignment. Incubation of the sludge with ribonuclease caused a decrease of the peak in the P-diester region, indicating that at least a part of the P-diesters is in the form of RNA. Results of a dialysis experiment appeared to indicate that P-diesters were broken down from the molecular weight > 1000 material to their lower molecular weight components during sludge digestion. The peaks appearing in the P31 NMR spectra of sludge-borne phospholipids were tentatively assigned to phosphatidylcholine, phosphatidylserine, phosphatidylethanolamine, and phosphatidylglycerol or diphosphatidylglycerol. (Author's abstract)
W90-00568

METHOD FOR EVALUATION OF ACIDIC SULFATE AND NITRATE IN PRECIPITATION.
Argonne National Lab., IL. Biological, Environmental, and Medical Research Div.
D. L. Sisterson.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 61-72, January 1989. 2 fig, 3 tab, 56 ref. U.S. Department of Energy (Office of Health and Environmental Research, National Acid Precipitation Assessment Program) Contract W-31-109-Eng-38.

Descriptors: *Pollutant identification, *Water analysis, *Acid rain, *Sulfates, *Nitrates, *Precipitation, Sulfur compounds, Nitrogen compounds, Air pollution, Tennessee, Pennsylvania.

Sulfur and nitrogen compounds in the atmosphere are primarily responsible for the acidity of precipitation, but the equivalents of SO4(--) and NO3(-) far exceed those for H(+) in precipitation in the eastern United States. A simple method is presented and used to estimate the portions of SO4(--) and NO3(-) that contribute to the strong acidity in weekly precipitation samples collected at three National Atmospheric Deposition Program sites in the eastern United States. The method assures that, in general, the difference between SO4(--) and NH4(+) represents acidic sulfate and the difference between NO3(-) and soil-derived materials represents acidic nitrate. Acidic sulfate and nitrate are considered to be the most predominant source of H(+) in the weekly precipitation samples. Most of the acidity for all three sites was attributed to acidic sulfate. The highest fraction of acidic SO4(--) to H(+) wet deposition values was for the east-central Tennessee site and the northeastern Illinois site, and the lowest fraction occurred at the central Pennsylvania site. The Tennessee site had the greatest acidic fraction of sulfate and the Pennsylvania site had the greatest acidic fraction of nitrate. (Author's abstract)
W90-00643

COLIFORM DETECTION FROM RIVER WATERS: COMPARISON BETWEEN MPN AND MF TECHNIQUES.
Bologna Univ. (Italy). Ist. di Microbiologia Agraria e Tecnica.
M. Grandi, G. Poda, D. Cesaroni, F. Cangamella, and L. D. Trovatelli.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 135-145, January 1989. 6 fig, 2 tab, 27 ref.

Descriptors: *Bioindicators, *Bacterial analysis, *Coliforms, *Bacteria, *Water quality, *Water pollution, *Membrane filters, Statistical analysis, Most probable number test, Regression analysis, Feces, Rivers.

The enumeration of total and fecal coliform bacteria is universally applied to document the sanitary quality of water. Three different methods were compared for use in determining fecal pollution in river water. Two of the methods were based on direct estimation using standard aerobic incubation of membrane filters (S-MF) and anaerobic incubation of membrane filters (A-MF); the third was based on statistical evaluation by the most probable number method (MPN). It was seen from regression analysis of the results obtained that the MPN, S-MF and A-MF techniques are equally valid as regards the enumeration of fecal coliforms, whereas the S-MF and A-MF techniques are more sensitive than the MPN procedure for the enumeration of total coliforms. (Author's abstract)
W90-00646

ANALYSIS OF PESTICIDES IN SEAWATER AFTER ENRICHMENT ONTO C8 BONDED-PHASE CARTRIDGES.
South Carolina Univ., Columbia. Dept. of Chemistry.
D. A. Hinckley, and T. F. Bidleman.
Environmental Science and Technology ESTHAG, Vol. 23, No. 8, p 995-1000, August 1989. 5 fig, 5 tab, 30 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Insecticides, *Pesticides, *Estuaries, *Chromatography, Agricultural chemicals, Silicon, Shrimp, Arctic Ocean, South Carolina, Halogenated pesticides, Organophosphorus pesticides, Fishkill, Pyrethroids.

A collection of organochlorine, organophosphate, and pyrethroid insecticides from distilled water, seawater of 33-35 parts per thousand salinity, and river water containing a high concentration of dissolved organic carbon (DOC) was examined. Water volumes of 1-4 liters were pulled at a flow rate of 15-40 milliliters per minute through a 47 millimeter glass fiber filter to trap particulate matter, followed by tandem 500 milligram C8 bonded silica cartridges. The cartridges were extracted with diethyl ether-hexane, the extract was blown down under nitrogen, and the analytes were quantified by capillary gas chromatography with electron capture detection. The cartridges were easy to clean and average blanks < or = 0.2 nanograms per liter were obtained. Breakthrough to back cartridges was 1-10% of the front cartridge quantity for most pesticides in the three types of water. Recoveries for a variety of pesticides at the 7-110 nanogram per liter level ranged from 85% to 120%. The collection method was used to determine pesticide concentrations in a tidal creek, where shrimp were killed during a runoff event, and hexachlorocyclohexane concentrations in ocean surface water and snow from the Arctic. (Author's abstract)
W90-00689

TESTING READSORPTION OF TRACE ELEMENTS DURING PARTIAL CHEMICAL EXTRACTIONS OF BOTTOM SEDIMENTS.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
N. Belzile, P. Lecomte, and A. Tessler.
Environmental Science and Technology ESTHAG, Vol. 23, No. 8, p 1015-1020, August 1989. 2 fig, 2 tab, 35 ref.

Descriptors: *Sample preservation, *Chemical analysis, *Heavy metals, *Trace elements, *Lake sediments, *Sediments, *Adsorption, *Sample preparation, Arsenic, Cadmium, Copper, Nickel, Lead, Zinc.

The importance of postextraction readsorption of arsenic, cadmium, copper, nickel, lead, and zinc has been evaluated for each step of a sequential extraction procedure by measuring the recovery of small amounts of trace elements added during the extraction of oxic lake sediments. For all the cases examined but one, the trace element spikes (less than 100% of the amount present in control samples) were recovered within the limits given by the experimental errors. These results contrast with the large percentages of postextraction readsorption observed for these trace elements in previous studies, a consequence of the use by previous investigators of either large spikes (greatly exceeding the amounts present in the control samples) during extractions of natural sediment or simple model sediments. (Author's abstract)
W90-00690

IONIC ALKYLLEAD COMPOUNDS IN ENVIRONMENTAL WATER AND SEDIMENTS.
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-00707

USE OF RADIONUCLIDES IN THE STUDY OF CONTAMINANT CYCLING PROCESSES.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
P. H. Santschi.
Hydrobiologia HYDRB8, Vol. 176/17, p 307-320, July 3, 1989. 5 fig, 3 tab, 34 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Sediment-water interfaces, *Heavy metals, *Radioisotopes, *Radioactive tracers, *Tracers, *Lakes, Coupling.

A multitracer approach was used to study the dynamic coupling of physical, chemical, and biological transport processes in lakes. Examples from two hard-water lakes in Switzerland: Lake Biel and Lake Zurich, give evidence for the resuspension of fine particles, radionuclides and trace metals from the horizontal boundaries focussing on their final repositories in the interior of the lake. The example from Lake Biel, a hardwater lake with a water residence time of 60 days, demonstrates the more dynamic nature of the trace metal profiles of Cu and Zn in lakes. More than 90% of these two trace metals in this lake originate from river inputs, mostly from the river Aare. Sixty percent of Zn, but only 20% of Cu is retained in the lake. Scavenging from the water column on particulate phases other than plankton and subsequent remobilization in the sediments can occur for the trace metals, such as Cu and possibly Zn, Mn and Pb. On the other hand, particles settling through the water-column and accumulating on the bottom continuously lose N. Another more recent example comes from a supposedly much less dynamic lake in Switzerland, Lake Zurich. From May to September 1986, about 20% of the total inventory of 134, 137Cs, but up to 80% of 103Ru was removed by particle scavenging and settling. The initial and September inventory of 134, 137Cs (134Cs: 137Cs = 0.55) in the lake has been estimated from measurements of total precipitation and from concentrations profiles in the lake, respectively. As the 137Cs flux decreased markedly during the first 2 months, a settling velocity of particles of 17 m/d can be calculated from the integrated flux ratio of 0.75 in the two traps (at 50 and 130 m depth) during the deployment receiving the pulsed input (April 29-May 20). However, from July to October 1986, the fluxes of 136Cs and 103Ru in the lower traps were consistently higher than those in the upper ones. This was, to a lesser extent, also true for particle fluxes in the lower traps. Since some of the 137Cs inventory was still residing in the upper 20 m of the lake at that time, this enhancement cannot be explained by increased scavenging rates with depths. It is likely that this phenomenon is caused by inputs from resuspensions of fine particles near the horizontal boundaries of the lake. (Miller-PTT)
W90-00720

UNCERTAINTY IN DESCRIPTION OF SEDIMENT CHEMICAL COMPOSITION.
Istituto Italiano di Idrobiologia, Novara.
For primary bibliographic entry see Field 7B.
W90-00731

MEASUREMENTS OF SEDIMENT TOXICITY OF AUTOTROPHIC AND HETEROTROPHIC PICOPLANKTON BY EPIFLUORESCENCE MICROSCOPY.
CB Research International Corp., Sidney (British Columbia).
For primary bibliographic entry see Field 5C.
W90-00738

TALITRID AMPHIPODS (CRUSTACEA) AS BIOMONITORS FOR COPPER AND ZINC.
Queen Mary Coll., London (England). School of Biological Sciences.
P. S. Rainbow, P. G. Moore, and D. Watson.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 6, p 567-582, June 1989. 9 tab. 30 ref. Nat. Env. Res. Council grant to P.S.R. (GR 3/5256).

Descriptors: *Pollutant identification, *Monitoring, *Bioindicators, *Bioaccumulation, *Amphipods, *Crustaceans, *Copper, *Zinc, *England, *Scotland, *Wales, Orchestia, Talorchestia, Talitrus, Cadmium, Industrial wastes.

Four talitrid amphipods (Orchestia gammarellus (Pallus), O. mediterranea Costa, Talitrus saltator Montagu and Talorchestia deshayessii (Audouin) were collected from 31 sites in S.W. Scotland, N. Wales, and S.W. England, and analyzed for copper and zinc concentrations. In addition, limited analyses were conducted on O. gammarellus and T. deshayesii for cadmium. In S. W. Scotland, copper concentrations were raised significantly in O. gammarellus from Whithorn and Auchencairn (Solway) and Loch Long and Holy Loch (Clyde). In S.W. England, copper concentrations were highest at Restronguet Creek, Torpoint and Gannel (Cornwall). Samples of O. gammarellus from Islay (inner Hebrides) taken adjacent to the effluent outfalls of local whisky distilleries fell into two groups based on copper concentrations (presumably derived from copper stills), the higher copper levels deriving from the more productive distilleries. High copper levels were found in T. saltator and T. deshayesii from Dulas Bay (Wales). Zinc levels in O. gammarellus were high in Holy Loch and Auchencairn (Scotland), Gannel and Torpoint (England) but extremely elevated (as was Zn in O. mediterraiea) at Restronguet Creek. Zinc was also high in T. saltator from Dulas Bay (Wales), but not in T. deshayesii. Cadmium levels in O. gammarellus from Kilve (Bristol Channel) were much raised. These differences (a) conform with expectations of elevated bioavailability of these metals from well researched areas (S.W. England and N. Wales), and (b) identify previously unappreciated areas of enrichment in S.W. Scotland. O. gammarellus is put forward as a suitable biomonitor for copper and zinc in British coastal waters. (Author's abstract)
W90-00783

HOW TO MONITOR GROUNDWATER AT A MUNICIPAL SOLID WASTE FACILITY.
Joyce Engineering, Inc., Princeton, WV.
W. L. Toney.
Public Works PUWOAH, Vol. 120, No. 9, p 76-79, August 1989.

Descriptors: *Monitoring, *Groundwater pollution, *Solid waste disposal, Geohydrology, Wells, Drilling, Organic wastes.

A monitoring program's ability to assess a solid waste disposal facility's integrity is founded upon adequate site hydrogeology information. Site hydrogeology requires the uppermost aquifer to be characterized, potential contaminant pathways identified, and groundwater movement rates determined. Detection monitoring wells must be located beyond the upgradient limit of contamination to provide samples representative of background water quality. The type of drilling method is site specific; however, to prevent cross-contamination between well installations drilling equipment must be carefully cleaned. In sample collection, the static water level should be measured to within 0.01 ft. Air in the well should be tested using an interface probe to determine light and dense phase organic layers. A fluorocarbon resin bailer can be used to obtain samples of the less dense organics. Once the depth to the water surface is determined, the bailer can also be modified to obtain dense phase organic samples. The sampling and analysis plan should also describe the chain of custody procedures to ensure that samples have not been disturbed during transportation. Statistical tests should be performed to determine if the waste disposal facility has impacted the groundwater. (White-Reimer-PTT)
W90-00796

DETECTABILITY OF STEP TRENDS IN THE RATE OF ATMOSPHERIC SULPHATE DEPOSITION.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and M. G. Kompter.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 31-41, March 1989. 2 fig, 6 tab, 13 ref.

Descriptors: *Acid rain, *Acid rain effects, *Monitoring, *Sulfur dioxide, Eastern North America, Step trend analysis, Model studies, Emission reduction.

Step trend analyses were performed on acid deposition rates using a combination of monitored sulfate deposition data and a long-range transport of acid precipitation (LRTAP) model. The step trend analyses consider Sudbury's emissions (a smelting company) and eastern north America's emissions in order to explore strategies for reducing SO2 emis-

sions to the extent that the decrease in sulfate deposition can be detected in a specified time period. Results indicate Sudbury's emissions could be reduced with significant detectable reduction in sulfate deposition occurring at the Muskoka region; however, decision makers would not be able to detect significant reductions of sulfate deposition at the other selected airsheds. The control of eastern North America's emissions indicate that a 50% reduction in emissions would require 5 yr of monitoring or less to detect a significant reduction. For a 35% reduction, 12 yr of monitoring or less would be required to detect a significant reduction in sulfate deposition. Boundary Waters and Algoma require longer periods of monitoring to detect a significant reduction in sulfate deposition because a large percentage of deposition is due to background deposition. The variability in the monitored data is large and tends to 'mask' the size of the magnitude of change required to detect a significant reduction in sulfate deposition. As a result, large reductions are required to detect any significant reductions. (White-Reimer-PTT)
W90-00801

ACIDIFYING POTENTIAL OF ATMOSPHERIC DEPOSITION IN CANADA.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W90-00810

DETECTION OF ENDOTOXINS IN RECLAIMED AND CONVENTIONALLY TREATED DRINKING WATER.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
J. S. Burger, W. O. K. Grabow, and R. Kfir.
Water Research WATRAG, Vol 23, No. 6, p 733-738, June 1989. 5 fig, 2 tab, 21 ref.

Descriptors: *Pollutant identification, *Toxins, *Drinking water, *Water treatment, *Wastewater renovation, *Water reuse, Disinfection, Namibia, South Africa.

The Windhoek (Namibia) and Cape Flats (South Africa) reclamation plants, which use different disinfection methods, were compared for their ability to remove endotoxins from feed water. Endotoxins were assayed using the Chromogenic Limulus Amoebocyte Lysate Assay (LAL). The Cape Flats reclamation plant, in which ozonation was used for disinfection prior to active carbon column treatment, was found to be more effective in endotoxin removal than the Windhoek plant in which only breakpoint chlorination steps were used. Both plants showed a significant increase in the level of endotoxins after active carbon column treatment. The level of endotoxins in the final water was found to be related to the level in the effluent after active carbon column treatment. Breakpoint chlorination was shown to contribute to the removal but not to the elimination of the endotoxins. The level of endotoxins in the final reclaimed water was compared to the level in surface and groundwater. The Cape Flats final water had lower levels than conventionally treated drinking water, and slightly higher levels than groundwater. (Author's abstract)
W90-00830

CONTINUOUS FLOW METHOD FOR DETERMINATION OF TOTAL TRIHALOMETHANES IN DRINKING WATER WITH MEMBRANE-SEPARATION.
Osaka Univ., Sakai (Japan). Lab. of Environmental Chemistry.
T. Aoki, and K. Kawakami.
Water Research WATRAG, Vol 23, No. 6, p 739-742, June 1989. 5 fig., 2 tab, 18 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Halogenated hydrocarbons, *Drinking water, *Membrane processes, Separation techniques, Laboratory methods.

A double-tube separation system with an inner tube of microporous poly(tetrafluoroethylene) (PTFE) and an outer tube of PTFE, is proposed for the continuous determination of TTHMs (total trihalomethanes) in drinking water. The TTHMs in the sample after mixing sodium sulfite solution, are separated with the double-tube system at 50 degree C and are mixed with alkaline nicotinamide solution, and then heated to 98 degrees C. After cooling in an ice bath, the reaction product is fed to a fluorometer and the fluorescence intensity excited at 372 nm is measured at 467 nm. There was no interference from unknown species existing in drinking water and river water by using the membrane separation system. A response was obtained within 8 min. The detection limit (S/N=3) was 0.8 microliter. The present method was applied to the determination of the TTHMs in drinking water. (Author's abstract)
W90-00831

VARIATIONS IN RAINWATER QUALITY FROM ROOF CATCHMENTS.
Pertanian Malaysia Univ., Serdang. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5F.
W90-00834

DETERMINATION OF AMMONIA IN WATER BY CENTRIFUGAL ANALYSIS.
Path Scientific Research Ltd., Halifax (Nova Scotia). Environmental Chemistry Lab.
R. F. McCurdy, R. Boss, and J. Dale.
Water Research WATRAG, Vol 23, No. 6, p 779-784, June 1989. 7 fig, 5 tab, 17 ref.

Descriptors: *Water analysis, *Chemical analysis, *Centrifugation, *Ammonia, *Natural waters, Laboratory methods, Detection limits, Precision.

A reliable and efficient procedure for measuring ammonia in natural waters using a Cobas-Fara centrifugal analyzer is described. The procedure, as optimized, has a detection limit of 9.01 mg/L. It is both accurate and precise; within-run precision varied from 0.69 to 0.74% and between-run precision varied from 0.74 to 2.13%. Analytical recovery ranged from 97.5 to 99.1%, and the results correlated well with those obtained by the standard phenate method. This procedure has several practical advantages including increased throughput (112 samples per h), decreased sample-size requirement (85 microliter) and technical ease of operation. (Author's abstract)
W90-00836

ATOMIC ABSORPTION SPECTROMETRIC MICRODETERMINATION OF TUNGSTEN (VI) IN ALLOYS AND ENVIRONMENTAL SAMPLES AFTER EXTRACTIVE SEPARATION WITH A HYDROXAMIC ACID INTO MIBK.
Pondicherry Univ. (India). Salim Ali School of Ecology.
S. A. Abbasi.
International Journal of Analytical Chemistry IJEAA3, Vol. 35, No. 3, p 139-147, 1989. 3 fig, 2 tab, 27 ref.

Descriptors: *Chemical analysis, *Tungsten, *Trace metals, *Pollutant identification, *Atomic absorption spectrophotometry, Alloys, Natural waters, Separation techniques.

Tungsten (VI) was selectively extracted from 2-8 M HCl or 15-20 M H_2SO_4 media with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA) in methyl isobutyl ketone (MIBK) and determined by atomic absorption spectrometer at 400.9 nm employing nitrous oxide-acetylene flame. The method was significantly more selective and sensitive than the prevailing methods for tungsten (VI) based on flame-AAS, and was successfully applied to the trace analysis of the metal in alloys, ores, plant tissues, animal tissues, and freshwaters. MFHA was chosen from amongst eleven new hydroxamic acids. (Author's abstract)
W90-00856

LIQUID CHROMATOGRAPHY SYSTEM FOR MEASUREMENT OF ORGANIC ACIDS IN PRECIPITATION.
Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
W. Elbert, J. Hahn, and M. Lerch.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 3, p 149-159, 1989. 4 fig, 2 tab, 37 ref.

Descriptors: *Water analysis, *Chemical analysis, *Chromatography, *Organic acids, *Acid rain, *Pollutant identification, Ion exchange, Chemistry of precipitation.

An ion chromatographic system was developed for routine measurement of carboxylic acids with carbon numbers up to C8 in precipitation samples. The system combines on-line sample preconcentration on a low-capacity anion exchange resin with separation by ion exclusion and subsequent detection by UV absorption. Detection limits (peak-to-noise ratio 10:1) of less than 0.4 micromol/liter are obtained for formic acid and acetic acid. Mineral acids such as sulfuric, nitric, and hydrochloric acid, which usually represent the main anions in continental precipitation over the northern hemisphere, do not interfere, since they elute as one peak in the beginning of the chromatogram. The chromatographic system has been tested for overlapping peaks with a variety of C1-C8 carboxylic acids, both saturated and unsaturated, substituted and unsubstituted, and with phenol and benzene. Not all organic anions are fully separated: oxalate, maleate, and the anions of various multifunctional organic acids up to tartrate and probably citrate are hidden under the large peak of the strong mineral acids; several other peaks were found to overlap by more than 50%. In many cases, this may not be important, since measurements by other groups and models of tropospheric photochemistry have shown that there are certain acids such as formic and acetic acids which generally predominate in the atmospheric mixture of acidic organic compounds. (Author's abstract)
W90-00857

CAPILLARY SPOT TEST FOR THE DETECTION OF TRACE LEVELS OF ORGANOPHOSPHORUS INSECTICIDES IN WATER, SOIL AND VEGETATION.
Aligarh Muslim Univ. (India). Dept. of Applied Chemistry.
H. S. Rathore, I. Ali, and A. Kumar.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 35, No. 3, p 199-206, 1989. 3 tab, 24 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pesticides, *Insecticides, *Organophosphorus pesticides, *Pollutant identification, *Pesticide residues, Soil contamination, Plants.

A simple inexpensive and sensitive spot test was developed for the detection of trace levels of organophosphorus insecticides such as malathion, formothion, thiometon, dichlorvos, methyl parathion, dimethoate and phosphamidon in water, soil (fertile and non-fertile) and in the leaves of Citrus medica (common lemon plant). Benzene solutions of p-dimethylaminobenzaldehyde and trichloroacetic acid were used together as the detection reagent. Using this method, the lower limits of detection of the organophosphorus compounds in water ranged from 2 micrograms for malathion to 10 micrograms for thiometon. Of the materials tested, the limit of detection of was lowest in water and highest in soils. (Geiger-PTT)
W90-00858

AUTOMATIC SYSTEM FOR SIMULTANEOUS DETERMINATION OF NITRATES AND NITRITES IN WATERS.
Universitat de les Illes Balears, Palma de Mallorca (Spain). Dept. de Chemistry.
J. Maimo, A. Cladera, F. Mas, R. Forteza, and J. M. Estela.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 35, No. 3, p 161-167, 1989. 2 fig, 1 tab, 7 ref.

Descriptors: *Water analysis, *Chemical analysis, *Nitrates, *Nitrites, *Pollutant identification,

*Spectrophotometry, Automation, Microcomputers, Dyes.

An automatic flow injection analysis system for simultaneous determination of nitrates and nitrates in waters is described. The method is based on the classical azodye reaction for nitrites. The sample is split into two flows: one is directly treated with the azodye reagent and sent to the sample flow cell of a double beam spectrophotometer, which gives positive absorbance values, allowing direct determination of nitrites in the sample, and the other flow goes through a cadmium reduction microcolumn, where nitrates are reduced to nitrites. The sample is then treated with the azodye reagent and the overall mixture is sent to the reference cell of the same double beam spectrophotometer, which gives negative peaks in the original sample from the difference. The procedure has been automatized by connecting a digital potentiometer, provided with a RS232C interface, to the register output of the spectrophotometer. The potentiometer is used as a data acquisition interface for an Amstrad 128 microcomputer. A specific program has been developed, allowing: data storage of the successive experiments, and data treatment for calculation of the calibration curves and automatic reports of the sample's nitrates and nitrites contents. (Author's abstract)
W90-00859

DETERMINATION OF LINEAR ALKYLBENZENESULPHONATES AND ALKYLPHENOL POLYETHOXYLATES IN COMMERCIAL PRODUCTS AND MARINE WATERS BY REVERSED- AND NORMAL-PHASE HPLC.
Venice Univ. (Italy). Dept. of Environmental Science.
A. Marcomini, S. Stelluto, and B. Pavoni.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 4, p 207-218, 1989. 3 fig, 2 tab, 23 ref.

Descriptors: *Water analysis, *Chemical analysis, *Surfactants, *Pollutant identification, *High performance liquid chromatography, Separation techniques, Seawater, Quantitative analysis.

Octadecylsilica was used as reversed-phase high-performance liquid chromatography packing material for the simultaneous separation and determination of linear alkylbenzenesulfonates (LAS) and nonylphenol polyethoxylates (NPEO). The role of NaClO4 dissolved in the mobile phase on the separation of LAS and NPEO was investigated: it turned out to affect only the elution volumes of LAS. Alkylphenol polyethoxylates were exhaustively extracted from liquid commercial cleaning products with hexane-acetone mixtures. A procedure for the determination of all the NPEO oligomers enriched from marine waters is presented. The LAS, NPEO and nonylphenol (NP) products from surface marine waters of the lagoon of Venice were enriched on C18 minicolumn cartridges. The analytes were desorbed from the cartridge with acetone and the eluted acetone solution was split into two equal fractions, one of which was used for determining LAS, NPEO, and NP by reversed-phase HPLC and the other fraction for determination by normal-phase HPLC. Results of the determinations agreed well with results for NPEO and LAS previously published. (Geiger-PTT)
W90-00860

TOWARDS A STANDARD METHOD FOR THE MEASUREMENT OF ORGANIC CARBON IN SEDIMENTS.
Colorado School of Mines, Golden.
For primary bibliographic entry see Field 7B.
W90-00861

SIMULTANEOUS DETERMINATION OF C1-C2 ALDEHYDES AND ORGANIC ACIDS IN AQUEOUS ATMOSPHERIC SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Netherlands Energy Research Foundation ECN, Petten.
M. P. Keuken, and C. A. M. Schoonebeek.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 35, No. 4, p 227-239, 1989. 6 fig, 2 tab, 42 ref.

Descriptors: *Water analysis, *Chemical analysis, *Acid rain, *Pollutant identification, *Organic acids, *High performance liquid chromatography, *Chemistry of precipitation, Rain, Dew, Mist, Acetic acid, Air pollution.

A high-performance liquid chromatographic method for the simultaneous determination of C1-C2 aldehydes and organic acids in aqueous samples was developed. Aldehydes and organic acids are separated after derivatization of the aldehydes by 2,4-dinitrophenylhydrazine and by gradient elution on reversed-phase material. Measurement is by UV and conductivity, respectively. The detection limits, using an injection volume of 100 microliters, for formaldehyde, acetaldehyde, formic acid and acetic acid are 5 micrograms/liter, 10 micrograms/liter, 15 micrograms/liter, and 30 micrograms/liter, respectively. Aldehydes are stabilized by the derivatization reagent for a period of maximal five days in the field. Results of measurements of rain, mist and dew samples, collected in Petten (The Netherlands) indicate the presence of C1-C2 aldehydes and organic acids in the range from 0.01 to 3 milligrams/liter. (Author's abstract)
W90-00862

TRACE ELEMENT SPECIATION IN CONTAMINATED SOILS STUDIED BY ATOMIC ABSORPTION SPECTROMETRY AND NEUTRON ACTIVATION ANALYSIS.
Ceske Vysoke Uceni Technicke v Praze. Fakulta Jaderna a Fysikalne Inzenyrska.
V. Spevackova, and J. Kucera.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 35, No. 4, p 241-251, 1989. 6 tab, 15 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Chemical analysis, *Trace elements, *Soil contamination, *Atomic absorption spectrophometry, *Neutron activation analysis, Leachates, Silver, Cadmium, Cobalt, Copper, Iron, Lithium, Manganese, Nickel, Lead, Antimony, Zinc.

Leachable forms of the elements Ag, Cd, Co, Cu, Fe, Li, Mn, Ni, Pb, Sb, and Zn were studied in soils with increased levels of the elements Ag, Cd, Pb, Sb, and Zn due to contamination by sewage sludges from a metallurgical plant as well as in control soil samples. The total element contents, except for Cu, Li, and Pb were determined by instrumental neutron activation analysis INAA. For quality assurance purposes, the reference materials IAEA Soil-5 and IAEA Soil-7 were also analyzed. Partitioning of the elements was studied by atomic absorption spectrometry (AAS) and partly by NAA using a multi-step sequential leaching procedure designed to divide elements into five fractions: exchangeable metals, metals bound to carbonates, metals bound to Fe-Mn oxides, metals bound to organic matter, and residual metals. Of the metals studied, Cd appeared to be most readily solubilized from the soil samples. Differences in leachabilities of the elements Co, Fe, and Zn from unirradiated and reactor irradiated samples are discussed. Samples analyzed by INAA and consequently used for leaching experiments were additionally ground and homogenized prior to irradiation to assure sufficient homogeneity for smaller sample weights used in contrast to the AAS procedure. Although the same solid-to-liquid phase ratio was kept, enlarged surface of the solid phase might influence the leaching of elements. The irradiation in the reactor by high fluences of neutrons and gamma-rays may change the physico-chemical properties of soils, especially the organic constituents thus affecting leachability. (Author's abstract)
W90-00863

SEPARATION OF METAL IONS IN TUBE WELL WATER SAMPLES BY THIN LAYER PARTITION CHROMATOGRAPHY.
Institute of Science, Nagpur (India). Dept. of Chemistry.
L. Deshmukh, and R. B. Kharat.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 36, No. 1, p 1-6, 1989. 4 fig, 1 tab, 8 ref.

Descriptors: *Water analysis, *Chemical analysis, *Thin layer chromatography, *Pollutant identification, *Metals, *Well water, Iron, Zinc, Copper, Lead, Manganese, Nickel, Separation techniques.

A thin layer chromatography (TLC) method was developed for the separation of Fe(III), Cu(II), Pb(II), Mn(II) and Ni(II) in well water. Thin layers of silica gel G were used as an adsorbent. Rf values were determined using 0.01-0.2 M aqueous sodium acetate as mobile phase. The dependence of the Rf values on the pH, the width of the plates and the time required for migration of the ions was studied. Optimum conditions for possible 3-, and 4-component separations were determined. Ni(II), Zn(II), Fe(III), Cu(II), Mn(II) and Pb(II) having minimum concentration of 0.65, 0.5, 4.0, 0.70, 0.5 and 2.0 micrograms/milliliter, respectively were separated. The present method was applied to the separation and detection of metal ions in tube well water samples from different villages of Orissa (India). Results showed that Fe(III) concentrations ranged from 15.2-16.7 micrograms/milliliter, Mn(II) concentrations were 0.6 micrograms/milliliter, and Zn(II) concentrations ranged from 0.6 to 3.6 micrograms/milliliter. (Author's abstract)
W90-00864

HOLDING TIME FOR SAMPLES FROM A FEW SELECTED LAKES AND STREAMS: EFFECTS ON TWENTY-FIVE (25) ANALYTES.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Acid Deposition Quality Assurance Group.
M. A. Stapanian, B. C. Hess, T. E. Lewis, and A. K. Pollack.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 36, No. 1, p 35-53, 1989. 1 fig, 4 tab, 36 ref. EPA Contract 658-03-3249.

Descriptors: *Pollutant identification, *Quality control, *Sample preservation, *Water analysis, *Chemical analysis, *Acid rain, Lakes, Streams, Metals, *Sampling, Surveys, Hydrologic data collections, Water quality, Hydrogen ion concentration, Water analysis.

Water samples collected from three lakes and seven streams in the eastern United States were held in cubitainers at a field laboratory for 12, 24, 48, and 84 hr before aliquots were prepared, preserved and sent to an analytical laboratory. One-factor repeated measures analyses of variance (RMANOVA) were used to test the effects of holding time on 25 chemical analytes, including 3 measures of pH. Regardless of the outcome of the RMANOVA, holding time was not of practical significance if the precision between holding times was less than the precision between standardized samples with no holding time. Holding time had a statistically significant effect on 17 analytes. However, the practical significance of holding time was negligible for all analytes with the exception of Fe, Mn, total Al, and pH. For Fe, Mn, and total Al, the practical significance of the effects of holding time was questionable. Based on these results and results from similar studies, syringes stored at 4 C are used as the reliable pH measurements for the National Surface Water Survey. The costs of water surveys that encompass large geographical areas can be reduced by using less expensive means of sample transport and shipment. (Author's abstract)
W90-00865

EVALUATION OF A GAS-PHASE SELECTIVE ELECTRODE FOR THE QUANTITATION OF AMMONIA IN LIQUID PIGGERY WASTES.
Laval Univ., Quebec. Dept. of Chemistry.
D. Manca, J. De La Noue, J. E. Cote, and J. Turcotte.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 36, No. 1, p 55-68, 1989. 3 fig, 6 tab, 31 ref.

Group 5A—Identification Of Pollutants

Descriptors: *Wastewater analysis, *Nutrients, *Waste disposal, *Land disposal, *Ammonia, *Animal wastes, *Electrodes, Nitrogen compounds, Suspended solids, Comparison studies, Regression analysis, Ureas.

A commercially available gas-sensing electrode for measuring the ammonia content of liquid piggery wastes (LPW) was evaluated. Samples previously acidified were analyzed directly without purification or separation steps. The influence of metal ions, urea, volatile amines and suspended solids on electrode response was verified at concentration ranges generally encountered in LPW samples but no effects were observed. Reproducibility of measurements over the range 12.4-89.0 mM as ammonia was satisfactory (cv = +or-5%) and recovered ammonia varied between 92% and 104%. Comparison of the electrode method to the standard distillation-titrimetric method yielded a close relationship as reflected by linear regression analysis on results (m = 1.01 +or-0.08; r = 0.997). With adequate arrangements, one analyst could perform up to 200 samples per day. (Author's abstract)
W90-00866

ATOMIC ABSORPTION SPECTROMETRIC AND SPECTROPHOTOMETRIC TRACE ANALYSIS OF URANIUM IN ENVIRONMENTAL SAMPLES WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND 4-(2-PYRIDYLAZO) RESORCINOL.
Pondicherry Univ. (India). Salim Ali School of Ecology.
S. A. Abbasi.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 36, No. 3, p 163-172, 1989. 3 fig, 2 tab, 26 ref.

Descriptors: *Chemical analysis, *Atomic absorption spectrophotometry, *Uranium radioisotopes, *Pollutant identification, Anions, Cations, Bismuth, Thorium, Cerium, Titanium, Zirconium, Molybdenum, Iron, Tungsten, Vanadium.

Methods are presented for the determination of uranium in the presence of various anions and cations which are usually associated with it in rocks, waters, minerals, nuclear fission products and biological materials. The methods are based on the solvent extraction of uranium(VI) as its complex with N-p-methoxyphenyl-2-furylacrylohydroxamic acid in chloroform, or methyl isobutyl ketone (MIBK) at pH 4.5-5.1. The uranium in the orange-yellow chloroform extract is either directly determined spectrophotometrically or back-extracted into 0.01 M HCl solution and determined as its intensely red colored complex (molar absorptivity = 39,500 l/mol/cm at 530 nanometers) with 4-(2-pyridylazo) resorcinol. The metal in the MIBK extract is determined atomic absorption spectrometrically by the aspiration of the extract in nitrous oxide-acetylene flame and measuring the absorbance at 358.5 nanometers resonance line. Both the methods are highly sensitive and selective, and were applied to the determination of uranium in waters, plants and animal tissues. (Author's abstract)
W90-00868

SYNERGISTIC SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROMETRIC ANALYSIS OF ZINC IN ALLOYS AND ENVIRONMENTAL SAMPLES WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND PYRIDYLAZO REAGENTS.
Pondicherry Univ. (India). Salim Ali School of Ecology.
S. A. Abbasi.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 36, No. 3, p 173-184, 1989. 2 fig, 7 tab, 21 ref.

Descriptors: *Chemical analysis, *Water analysis, *Zinc, *Atomic absorption spectrophotometry, *Spectrophotometry, *Pollutant identification, Natural waters, Coal, Plant tissues, Animal tissues.

Zinc (II) was selectively extracted from aqueous solutions of pH 7.8-8.5 into chloroform with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA). 1-(2-Pyridylazo)-2-naphthol (PAN) or 2-((5-nitro-2-pyridyl)azo)-1-naphthol (NPAN) were added to the extract to form intensely colored ternary complexes measurable spectrophotometrically at 550 nanometers (molar absorptivity = 60,300 l/mol/cm) and 625 nanometers (molar absorptivity = 81,500 l/mol/cm), respectively. For atomic absorption spectrometric analysis, methyl isobutyl ketone (MIBK) was used as extracting solvent instead of chloroform and the zinc-MFHA-MIBK extract was aspirated directly into an air-acetylene flame. The absorbance was measured at the 213.9 nanometers resonance line with a detection limit of 0.05 ppb, which was significantly better than the limit of 1.0 ppb achieved for zinc previously with flame AAS. The method tolerated a large number of anions and cations normally occurring with zinc in environmental samples, and was applied to the trace analysis of zinc in alloys, coal, plant tissues, animal tissues and natural waters. The combinations of MFHA and PAN/NPAN were chosen from eleven hydroxamic acids and nine pyridylazo reagents. (Author's abstract)
W90-00869

EVALUATION OF EPA METHOD 8120 FOR DETERMINATION OF CHLORINATED HYDROCARBONS IN ENVIRONMENTAL SAMPLES.
Acurex Corp., Mountain View, CA. Environmental Systems Div.
V. Lopez-Avila, N. S. Dodhiwala, J. Milanes, and W. F. Beckert.
Journal-Association of Official Analytical Chemists JANCA2, Vol. 72, No. 4, p 593-602, July/August 1989. 7 fig, 5 tab, 26 ref.

Descriptors: *Water analysis, *Quality control, *Chlorinated hydrocarbons, *Pollutant identification, *Gas chromatography, Column separation, Benzenes, Quantitative analysis, Soil analysis, Sediments, Water analysis.

Method 8120 of EPA Manual SW-846 has been evaluated in a single-laboratory study. Several modifications made to the current method were implemented to allow determination of selected chlorinated hydrocarbons in complex environmental samples. The 2 packed gas chromatographic columns specified in Method 8120 were replaced with 2 megabore fused-silica open tubular columns chemically bonded with trifluoropropylmethyl siloxane and polyethylene glycol, respectively. The list of target compounds was expanded from 15 to 22 to include all possible trichlorobenzenes, tetrachlorobenzenes, and hexachlorocyclohexane (BHC) isomers. The Florisil cleanup procedure was modified to allow quantitative recovery of 20 of the 22 target compounds. A procedure that uses 1 g Florisil disposable cartridges and hexane-acetone (9:1) eluant was developed. This latter procedure gives quantitative recovery of all 22 target compounds from all matrices tested. The revised method was tested with a variety of sample matrices. Detection limits for water samples ranged from 1.4 nanograms/liter for hexachlorobutadiene to 1300 nanograms/liter for 2-chloronaphthalene; detection limits for 15 compounds were below 40 nanograms/liter. Because of background contamination, detection limits for soil and sediment samples need to be determined on a case-by case basis. (Author's abstract)
W90-00870

VOLATILE ORGANIC LOSSES FROM A COMPOSITE WATER SAMPLER.
Tennessee Eastman Co., Kingsport.
For primary bibliographic entry see Field 7B.
W90-00900

FLOW CYTOMETRY FOR ALGAL STUDIES.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 7B.
W90-00903

RESULTS OF THE HARMFUL EFFECTS OF SELECTED WATER POLLUTANTS (ANILINES, PHENOLS, ALIPHATIC COMPOUNDS) TO DAPHNIA MAGNA.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5C.
W90-00910

RESULTS OF THE HARMFUL EFFECTS OF WATER POLLUTANTS TO DAPHNIA MAGNA IN THE 21 DAY REPRODUCTION TEST.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5C.
W90-00911

EVALUATION AND COMPARISON OF ION CHROMATOGRAPHY, SEGMENTED FLOW ANALYSIS AND FLOW INJECTION ANALYSIS FOR THE DETERMINATION ON NITRATE IN NATURAL SURFACE WATERS.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Inorganic Chemistry Section.
E. M. Burke, F. X. Suarez, D. C. Hillman, and E. M. Heithmar.
Water Research WATRAG, Vol. 23, No. 4, p 519-521, April 1989. 1 fig, 1 tab, 13 ref. EPA Contract No. 68-03-3249.

Descriptors: *Pollutant identification, *Nitrates, *Comparison studies, *Water analysis, Chromatography, Colorimetry, Detection limits, Sulfates, Chlorides.

A study to evaluate the comparability of ion chromatography (IC), segmented flow analysis (SFA), and flow injection analysis (FIA) for the determination of nitrate in natural surface waters has been completed. Assessment of method performance was based on the precision, accuracy, detection limit and analysis rate obtained from analyses of synthetic and natural samples by each technique. Precision (as RSD) and accuracy (as % recovery) for each method are typically 3 and 103% for IC, 1 and 101% for SFA and 1 and 100% for FIA, respectively. The method detection limits (expressed as mg/L nitrate ion) were 0.007 mg/L for IC, 0.006 mg/L for SFA and 0.030 mg/L for FIA. IC analysis time is 10 samples/h, however chloride and sulfate can be determined along with nitrate in a sample run. SFA and FIA can analyze 30-60 samples/h, but only nitrate can be determined. The calorimetric method responses were significantly larger than IC responses. The bias is apparently related to the sample matrix but has not been traced to any single matrix components. No relationship to dissolved organic carbon (DOC) was observed. (Author's abstract)
W90-00913

5B. Sources Of Pollution

AGRICULTURAL NONPOINT SOURCE POLLUTION: MODEL SELECTION AND APPLICATION.
Developments in Environmental Modeling, 10, Elsevier, New York. 1986. 409p. Edited by Aldo Giorgini, Franco Zingales, Alessandro Marani and Jacques W. Delleur.

Descriptors: *Nonpoint pollution sources, *Agricultural runoff, *Model studies, *Path of pollutants, *Water pollution sources, Hydrologic models, Water quality, Groundwater pollution, Geohydrology.

This volume contains most of the scientific contributions to the workshop 'Prediction of Agricultural Nonpoint Source Pollution: Model Selection and Application' held in Venice, Italy, in June 1984. In addition, contributions of specialists who were unable to attend the workshop are included, in an attempt to make the work more complete. Major topics discussed include: water quality models, agricultural pollution, groundwater movement, sediment transport, transport models, agricultural runoff, nonpoint pollution sources, mathematical discussions of pollutant transport and dispersion, and hydrologic models appropriate to analyses of

agricultural pollution. (See W90-00002 thru W90-00021) (Lantz-PTT)
W90-00001

REVIEW OF HYDROLOGIC AND WATER QUALITY MODELS USED FOR SIMULATION OF AGRICULTURAL POLLUTION.
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 9-35, 7 fig, 50 ref.

Descriptors: *Nonpoint pollution sources, *Agricultural runoff, *Hydrologic models, Simulation analysis, Nutrients, Fertilizers, Erosion, Path of pollutants, Pesticides, Computer programs, Computer models, Organic compounds, Agricultural chemicals, Reviews.

Nonpoint source simulation programs are part of a category of loading models which describe primarily formation of runoff and generation of pollutants from a source area. They can be divided into continuous simulation models or event oriented models. They also can be based on the distribution parameter or lumped parameter concept. In scope, they range from small, field-size application models to mostly deterministic, process-oriented, large watershed models. The available models range from simple application of the long term form of the Universal Soil Loss Equation, to medium complexity models that use a simple hydrological component, to multiple parameter-multicomponent models, requiring a large computer memory and a considerable amount of field data for calibration. Models have been developed to simulate hydrology, erosion and sediment process, nutrient (fertilizer) losses, and transport of organic chemicals from agricultural watersheds. From a large number of models that have been developed in the United States in the last ten years, this paper focuses on those that are in practical use and/or have been used by practitioners for managing nonpoint pollution from agricultural operations, including: Areal Nonpoint Source Watershed Environment Response Simulation (ANSWERS); Agricultural Chemical Transport Model (ACTM); the Hydrologic Simulation Program (HSPF); the Agricultural Runoff Management Model (ARM); Cornell Nutrient Simulation (CNS); Cornell Pesticide Model (CPM); and the Chemical Runoff, and Erosion for Agricultural Management Systems (CREAMS). (See also W90-00001) (Lantz-PTT)
W90-00002

RAINFALL ABSTRACTION AND INFILTRATION IN NONPOINT SOURCE POLLUTION.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 55-77, 1 fig, 51 ref.

Descriptors: *Interception, *Rainfall infiltration, *Surface-groundwater relations, *Nonpoint pollution sources, *Rainfall-runoff relationships, *Infiltration, Mathematical models, Path of pollutants, Depression storage, Mathematical studies, Numerical analysis, *Hydraulic conductivity, Spatial distribution, Water loss.

Hydrology plays an important role in the understanding of nonpoint source pollution. Hydrologic variables such as rainfall intensity, volume of rain, rainfall interception, infiltration, watershed storage and conveyance characteristics are strongly related to the pollutant loadings from agricultural areas. Simulation models of nonpoint source pollution are therefore based on this watershed hydrology. This paper is concerned with components of the rainfall-runoff process, mainly interception, depression storage and infiltration. Interception of water via vegetation, and depression storage of water forming puddles, are only briefly mentioned. There is a large variety of models describing the infiltration phenomenon; simple models such as the Green-Ampt model, or empirical models such as Holtan's model are often successfully used to describe this facet of the hydrologic cycle. However, more complete solutions, such as that of Philip and other numerical solutions, are usually needed to gain a better understanding of the infiltration and of the accompanying water redistribution in the soil. The stochastic variation of the flow parameter, principally the hydraulic conductivity, is generally recognized, but simple solutions of the spatial variation of the infiltration at the field scale or at the watershed scale are difficult to obtain and are the subject of current research. However, it appears that variability in space may outweigh the variability in time, that is, the points in a field or a watershed that are the wettest or the driest, consistently keep this characteristic in time. (See also W90-00001) (Lantz-PTT)
W90-00004

LATERAL MOVEMENTS OF VADOSE WATER IN LAYERED SOILS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. Giorgini, and M. Bergman.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 79-109, 10 fig, 95 ref.

Descriptors: *Groundwater movement, *Vadose water, *Soil water, *Groundwater pollution, *Path of pollutants, Mathematical studies, Infiltration, Isotropy, Geohydrology, Sorptivity, Soil porosity.

Since groundwater contamination is becoming recognized as a serious problem both in the United States and abroad, and since the contamination processes involve the vadose zone below the soil surface, the question on whether infiltration may occur in directions other than vertical, is one of importance. In this paper it is shown that, under particular conditions, which are chosen to emphasize the importance of the problem, lateral infiltration occurs and it can be more predominant than vertical infiltration. Specifically, that in the case of nonisotropic soils, infiltration through an incline may lead to lateral flow. For those geometrical combinations of parameters which lead to absorption simulation the lateral flow can be calculated in terms of those geometrical parameters, of Philip's sorptivity, and of two new properties of porous media which have been called absorption conveyance and gravitation conveyability. (See also W90-00001) (Lantz-PTT)
W90-00005

EROSION AND SEDIMENT TRANSPORT PROCESSES FOR AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Lafayette, IN.
For primary bibliographic entry see Field 2J.
W90-00006

SOME ASPECTS OF SOIL EROSION MODELLING.
Centro di Studio per la Genesi Classificazione e Cartografia del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2J.
W90-00009

APPLICATION OF AN AGRICULTURAL WATER BALANCE AND EROSION MODEL IN ENVIRONMENTAL SCIENCE.
Los Alamos National Lab., NM. Environmental Science Group.
For primary bibliographic entry see Field 2J.
W90-00010

SELECTION AND APPLICATION OF MODELS FOR NONPOINT SOURCE POLLUTION AND RESOURCE CONSERVATION.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
R. A. Leonard, and W. G. Knisel.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 213-229, 3 fig, 1 tab, 33 ref.

Descriptors: *Model studies, *Resources management, *Conservation, *Water pollution sources, *Nonpoint pollution sources, *Path of pollutants, Water quality management, Agricultural runoff, CREAMS, Pesticides, Runoff, Water pollution control, Land management.

Mathematical models to assess nonpoint source pollution and evaluate effects of management practices for its control are needed to adequately respond to water quality legislation of the past 5 years. Consequently, the US Department of Agriculture, Agricultural Research Service, has developed CREAMS, a field-scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The model includes components for hydrology, erosion/sediment yield, and chemical transport that describe the movement in runoff of sediment and its characteristics, plant nutrients, and pesticides from field-sized areas. It is a continuous simulation model that operates efficiently to allow consideration of long records (20 years). The utility of the model is evaluation of alternate management practices for their impact on the yield of sediment and chemical pollutants from field-sized areas at specific sites. Utility of the model in evaluating runoff of pesticides with different properties from two very different soils has been demonstrated. A number of alternate land management practices (terracing, conservation tillage, etc.) can also be proposed; and after evaluation of each with CREAMS, a practice could be chosen from those judged to adequately control sediment and chemical yield. (See also W90-00001) (Lantz-PTT)
W90-00012

SIMPLE MODELS TO EVALUATE NONPOINT POLLUTION SOURCES AND CONTROLS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, B. J. Barfield, and R. C. Warner.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 231-263, 12 fig, 6 tab, 47 ref.

Descriptors: *Model studies, *Nonpoint pollution sources, *Water pollution control, *Mathematical models, *Path of pollutants, Agricultural runoff, SEDIMOT II, Flow rates, Sediment transport, CREAMS, MUSLE, DEPOSITS, CSTRS, GRASSFIL.

When selecting an algorithm for a nonpoint source model, it is important to strike a balance between complexity and ease of use, so that the predictions can be made with the desired accuracy without requiring that the user become an expert hydrologist. In the development of SEDIMOT II, a design aid model for sediment control structures, an attempt was made to strike such a balance. SEDIMOT II is a distributed parameter model in which runoff and sediment yield are determined for each homogeneous subwatershed and routed downstream to structures and junctions. Runoff is determined with curve number techniques utilizing unit hydrographs with differing shapes depending on land use. Channel routing is accomplished with Muskingum's method. Sediment yield is calculated with either the MUSLE or CREAMS equations. The time distribution is determined by a power relationship between sediment concentration and flow rate. The size distribution is determined by an algorithm which assumes tat the larger particles are deposited first. Sediment routing through ponds is determined from either the DEPOSITS plug flow model or the more recent Continuous Stirred Tank Reactor in Series (CSTRS) model. Sediment routing through grass filters is calculated by the GRASSFIL model and through check dams by a combination of a water surface profile model and Camp's overflow rate model. (See also W90-00001) (Author's abstract)
W90-00013

FIELD SCALE SIMULATION OF NUTRIENT LOSSES.

Padua Univ. (Italy). Ist. di Chimica Industriale.
G. Bendoricchio, and A. Rinaldo.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 277-293, 6 fig, 23 ref.

Descriptors: *Nutrient removal, *Nonpoint pollution sources, *Field tests, *Simulation analysis, *Nutrients, *Path of pollutants, *Hydrologic models, Agricultural runoff, Mathematical equations, Mathematical models, Model studies, Estimating, Numerical analysis, Performance evaluation, Agricultural watersheds.

The rationale for a conceptual model of a unit-mass response function (UMRF) for simulation of nutrient losses from agricultural watersheds is recalled. The model consists of an extension of the well-known hydrological model, with agricultural basins represented by a cascade of continuously stirred tank reactors (CSTR). Hysteretical phenomena in pollutant concentration/water discharge relations, appearing both in the mathematics of the model as well as in experimental observations, are discussed. Features of the mathematical model include: optimal transformation of the lumped parameter structure into a large-scale distributed parameter structure ; parsimonious hydrological and chemical input; computational reliability; and capacity for continuous simulation and forecasting. Furthermore, the model structure allows for separate estimation of hydrological parameters and pollutant fixed and mobile phase parameters. The results of numerical experiments aimed at emphasizing the sensitivity of the model to chemical parameter variations and the ramifications for field-scale simulation are discussed. The results imply that the equilibrium concentration (C sub E) is the dominant parameter. In fact, average annual values of C sub E would suffice for total annual evaluations although a loss accuracy in event-based simulation may occur. (See also W90-00001) (Lantz-PTT)
W90-00015

RUNOFF AND RECEIVING WATER MODELS FOR NPS DISCHARGE INTO THE VENICE LAGOON.
Padua Univ. (Italy). Ist. di Idraulica.
A. Rinaldo, and A. Marani.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 319-344, 11 fig, 7 tab, 51 ref.

Descriptors: *Path of pollutants, *Model studies, *Runoff, *Hydrologic models, *Nonpoint pollution sources, *Venice Lagoon, *Italy, Mathematical models, Nutrients, Tidal hydraulics, Simulation analysis, Model testing, Spectral analysis, Flow profiles.

In models of pollution in Venice Lagoon, Italy, nonpoint source pollution (NPSP) annual average nutrient loadings are recognized together with source areas and spatial location of delivery. Novel theoretical grounds for mathematical modeling aimed at simulation of water quality within the Lagoon are presented. This approach, which focuses on long-term NPSP impacts, yields analysis of the features of NPSP models suitable to comprehensive simulations. The models consist of multiple-box mass balances of water and pollutants at nonconstant flow rates portraying the tidal hydraulic behavior of the water body. Spectral analyses of calculated and measured tidal elevation data were performed and comparisons are made between the hydraulic regime of the proposed model and transfer functions of static models (successfully used to evaluate water volumes exchanged by the sea with lagoon). The chemical behavior of the storages in Venice Lagoon can be approximated by that of a continuous stirred tank reactor. Sample runs of the model for pollutant propagation through the multiple-box net are presented. The research brought to light some relevant points concerning the integration of runoff and receiving water models: (1) the use of a combination of screening and unit-mass response function approaches for identification of potential NPSP source areas and resolution of inputs for the receiving water model; (2) the impracticality of zero-order approaches or refined distributed parameter modeling for the mainland under study; (3) the possibility of consistent linearizations of water mass and momentum balance for the receiving water body, based on spectral analyses of experimental data and of computed results; and (4) the computational advantages of the proposed multiple-box approach for long-term simulations. (See also W90-00001) (Lantz-PTT)
W90-00017

DISTRIBUTED PARAMETER HYDROLOGIC AND WATER QUALITY MODELING.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 345-362, 5 fig, 3 tab, 14 ref.

Descriptors: *Parametric hydrology, *Model studies, *Nonpoint pollution sources, *Path of pollutants, *Water quality control, *Hydrologic models, *Water quality management, ANSWERS, Agricultural watersheds, Water pollution control, Watershed management, Cost analysis.

The merits of comprehensive watershed models in planning nonpoint source pollution control programs have been delineataed. Philosophical considerations of alternative modeling concepts applicable to simulating nonpoint source pollution on a watershed scale are presented. Examples of the output from a distributed model, ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation), have shown the special relevance of such models to national water quality planning programs. The discussion and examples are intended to support the following conclusions: (1) a distributed parameter modeling concept offers several advantages over lumped parameter approaches including potential increased accuracy, increased information content in the output, and the capacity to utilize results of plot and small watershed research for development of component relationships; (2) the effectiveness of any water quality control program is entirely dependent upon the quality of those trained individuals charged with planning and implementing the program; (3) an effective watershed model is an essential tool for increasing the efficiency and effectiveness of those key individuals; and (4) the detailed output of a distributed parameter model is essential for water quality planning programs because it allows planners to be site-specific in developing and evaluating the effectiveness of potential control measures. Such an approach is a prerequisite for recommending cost-effective measures for controlling nonpoint pollution from agricultural areas while still maintaining productive capacity. (See also W90-00001) (Lantz-PTT)
W90-00018

MODELS OF STATISTICAL DISTRIBUTIONS FOR NPSP CONCENTRATIONS.
Venice Univ. (Italy). Facolta di Chimica Industriale.
A. Marani, and G. Bendoricchio.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 363-382, 5 fig, 6 tab, 28 ref.

Descriptors: *Probability distribution, *Statistical models, *Nonpoint pollution sources, *Path of pollutants, Nitrogen, Model studies, Statistical analysis, Data interpretation, Simulation analysis, Forecasting, Mathematical equations.

Normal, lognormal, standard gamma and generalized gamma statistical distributions are analyzed for modeling experimental distributions of total-N concentrations in the runoff from a test agricultural catchment. Parameter estimation has been carried out via the maximum likelihood method. Comparison among the various distributions has been performed by several goodness-of-fit statistics. A model is proposed for viable physical interpretations of chemical concentrations gaged in agricultural runoff. Model performance is compared with that of previous approaches by means of two experimental data sets of total-N concentrations. Some conclusions can be drawn from the present research: (1) nonpoint pollution sources (NPS) chemical concentration distributions can neither be regarded as normal nor as lognormal; (2) concentration distributions constitute useful supports to deterministic modeling for comparisons with experimental data and forecasting control; (3) parameter estimation is tied to the chosen fitting criterion of experimental distributions; and (4) the choice of the fitting procedure cannot be carried out directly on experimental data fits because such models embody mixing effects with earlier events. Suitable simulations for critical point evaluations of the various fitting procedures are being performed. (See also W90-00001) (Lantz-PTT)
W90-00019

DEVELOPMENT, TESTING, AND APPLICATIONS OF NONPOINT SOURCE MODELS FOR EVALUATION OF PESTICIDES RISK TO THE ENVIRONMENT.
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5C.
W90-00020

FIELD DATA ACQUISITION SYSTEMS.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W90-00021

U.S. GEOLOGICAL SURVEY PROGRAM ON TOXIC WASTE--GROUND-WATER CONTAMINATION: PROCEEDINGS OF THE SECOND TECHNICAL MEETING, CAPE COD, MASSACHUSETTS, OCTOBER 21-25, 1985.
Geological Survey, Reston, VA.
Available from the National Technical Information Service, Springfield, Virginia 22161. USGS Open-File Report 86-481, 1988. 189p. Edited by Stephen E. Ragone.

Descriptors: *Path of pollutants, *Geohydrology, *Hazardous wastes, *Path of pollutants, *Groundwater pollution, *Fate of pollutants, Research priorities, Conferences, Microbiological studies, Physical properties, Chemical properties, Nonpoint pollution sources.

The US Geological Survey's (USGS) Program on Toxic Waste--Groundwater Contamination (the Toxic Waste Program) provides a focus for ongoing and the opportunity for new, earth science research on the fate and transport of toxic wastes in groundwater. In fiscal year 1986, the Toxic Waste Program consisted of three research activities: (1) basic research of the physical, chemical, and microbiological factors affecting the fate of contaminants in groundwater; (2) point source field research at sites where groundwater contamination has occurred; and (3) nonpoint source contamination research to understand the influence of human activities on regional groundwater quality. The objective of the Toxic Waste Program is to extent current understanding of earth science processes to better describe the fate of contaminants in the complex multiphase and multicomponent systems found in nature. Some study of processes, occurring in the unsaturated zone and surface water also are being conducted to evaluate their impact on groundwater transport of contaminants. In October 1985, a meeting was held on Cape Cod, Mass., to review the technical progress of the Toxic Waste Program. This report provides a brief description of the major components of the program and includes selected abstracts of presentations made at the meeting. (See W90-00023 thru W90-00051) (Lantz-PTT)
W90-00022

CLAY MINERALOGY OF SEDIMENTS ASSOCIATED WITH A PLUME OF CREOSOTE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2K.

W90-00023

GEOCHEMISTRY OF A SHALLOW AQUIFER CONTAMINATED WITH CREOSOTE PRODUCTS.

Geological Survey, Reston, VA.
M. J. Baedecker, B. J. Franks, D. F. Goerlitz, and J. A. Hopple.

IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p A17-A20, 5 fig, 2 ref.

Descriptors: *Chemical wastes, *Path of pollutants, *Geochemistry, *Aquifers, *Creosote, *Groundwater pollution, Pensacola Bay, Iron oxide, Organic compounds, Leachates, Silt, Clays, Chemical interactions, Florida, Oxidation-reduction potential, Plumes, Carbon dioxide, Sulfides, Sorption.

The geochemistry of water in a surficial sand and gravel aquifer in Pensacola, FL, has been significantly altered by buried creosote products from a wood-treatment plant. South of the contaminated area, a silt and clay lens about 11 m thick separates the leachate into a shallow plume (2-6 m below land surface) and a deeper plume (17 to 35 m below land surface). The leachate plume in the shallow system, as indicated by the distribution of dissolved methane, flows southward to Pensacola Bay in several lobes. An initial increase in concentrations or iron and sulfide followed by a decrease is consistent with their removal by the formation of iron sulfides. The water is supersaturated with respect to several forms of iron sulfides. A rapid decrease in concentrations of organic compounds downgradient may be related to several processes, including: (1) sorption of organic compounds on aquifer materials; (2) aerobic degradation by oxygen from the atmosphere; (3) fermentative degradation; and (4) reduction of iron oxides. In this part of the aquifer, the first two processes are not likely to attenuate large concentrations of organic carbon. The reduction of iron oxides, which are present throughout the aquifer, and the oxidation of organic compounds, generate ferrous iron and carbon dioxide. The concentrations of iron in solution are not large (0.04 mmol/L), so that the iron that is solubilized is reprecipitated as iron sulfides or incorporated into clays. The shallow system becomes anoxic a meter or two below the water table. The most abundant dissolved constituents are organic compounds and carbon dioxide. Both constituents increase gradually to a depth of 4 m, then increase to about 9 mmol/L where the plume is encountered. Concentrations of most dissolved inorganic constituents in the leachate are low because creosote contaminants are primarily organic compounds and because the leachate is in contact with an aquifer matrix of clean quartz sand with small amounts of clay and oxide coatings on sand grains. (See also W90-00022) (Lantz-PTT)
W90-00024

REEXAMINATION OF THE OCCURRENCE AND DISTRIBUTION OF CREOSOTE COMPOUNDS IN GROUND WATER.

Geological Survey, Menlo Park, CA.
D. F. Goerlitz.

IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p A21-A26, 1 fig, 6 tab, 5 ref.

Descriptors: *Groundwater pollution, *Creosote, *Path of pollutants, Nitrogen, Fate of pollutants, Aquifers, Organic compounds, Quinoline, Quinolinone, Overland flow.

In October 1984, a finding of creosote contamination in the groundwater, about 300 m, southeast of an abandoned wood-treatment plants at Pensacola, FL, prompted reconsideration of previous evaluations of the study site. Recent investigations at this and other sites have demonstrated that locating contaminated groundwater by hydrologic considerations only is unreliable. Also, as observed at Pensacola, use of nonspecific chemical determinations, such as dissolved organic carbon, colorimetric phenols, and selected inorganic analysis, is unsatisfactory for adequately delineating the volume of contamination. The most definitive approach is specific chemical testing. Because the accurate location of the contamination is essential to understanding the transport and fate of the contaminants, and because this had not been achieved at Pensacola, a decision was made not only to resample the contaminated area, but also to perform onsite, definitive chemical analysis during the drilling. Results of the sampling may be summarized as follows: (1) specific chemical determinations are needed to adequately delineate the contaminated parts of an aquifer because hydrologic and nonspecific chemical tests may fail to provide adequate information; (2) soluble nitrogen heterocycles are abundant in groundwater near the former ponds, but are transformed or degraded in the aquifer--nitrogen heterocycles in water samples taken from the 6 m depth were not detected > 150 M downgradient from the original ponds; (3) the nitrogen heterocycles in groundwater appear to undergo transformations or degradation, not only in the aerobic but also the anaerobic part of the aquifer--quinoline, isoquinoline, 2-quinolinone, and 1-isoquinolinone, the most abundant compounds in groundwater near the site, all appear to readily degrade in the deeper parts of the aquifer; and (4) at this site, overland flow and land-surface features have substantially influenced the upper 6-10 m of the groundwater. Factors such as the changes in surface-drainage patterns, overland flow of liquid hydrocarbon, and subsequent burial of the pooled hydrocarbons, all together have complicated the near-surface systems. (See also W90-00022) (Lantz-PTT)
W90-00025

DETERMINATION OF THE RATES OF ANAEROBIC DEGRADATION OF THE WATER-SOLUBLE FRACTION OF CREOSOTE.

Geological Survey, Menlo Park, CA.
E. M. Godsy, and D. F. Goerlitz.

IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p A27-A32, 4 fig, 5 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Creosote, *Anaerobic digestion, Phenols, Organic compounds, Chemical analysis, Quinoline, Formic acid, Propionic acid, Benzoic acid.

Creosote is the most extensively used insecticide and industrial wood preservative in use today. The major classes of compounds previously identified in creosote show that it consists of about 85% by weight polynuclear aromatic compounds, about 12% phenolic compounds, and about 3% heterocyclic nitrogen, sulfur, and oxygen containing compounds. Large but unknown quantities of the waste from the wood-preserving plant at Pensacola, FL, infiltrated the soil and moved downward to the water table. Upon reaching the water table, the creosote mixed with the groundwater, and two distinct phases resulted--a denser than water hydrocarbon phase that moved vertically downward somewhat perpendicular to the direction of groundwater flow, and an aqueous phase. Anaerobic degradation experiments were conducted with laboratory scale digestors in which only the water soluble fraction and the aquifer material were used to determine the biodegradability of the nitrogen heterocyclic compounds and the phenolic compounds under anaerobic conditions. Results indicate that, along with the phenolic compounds and organic acids previously reported to be anaerobically biodegradable, the nitrogen containing compounds, quinoline, isoquinoline, 2-quinolinone, 1-isoquinolinone, also are anaerobically biodegradable. The degradation times indicate a sequential three part degradation of these compounds in the following order: (1) 50 days--quinoline, isoquinoline, benzoic acid, formic acid, and propionic acid; (2) 100 days--phenol; and (3) > 100 days--2-, 3-, 4-methyl phenol, 2-quinolinone; and 1-isoquinolinone. (See also W90-00022) (Lantz-PTT)
W90-00026

CONTAMINATION, BIOACCUMULATION, AND ECOLOGICAL EFFECTS OF CREOSOTE-DERIVED COMPOUNDS IN THE NEAR-SHORE ESTUARINE ENVIRONMENT OF PENSACOLA BAY, FLORIDA.

Geological Survey, Reston, VA.
P. V. Dresler, and J. F. Elder.

IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p A33-A37, 2 fig, 1 tab.

Descriptors: *Creosote, *Path of pollutants, *Bioaccumulation, *Fate of pollutants, *Water pollution effects, *Estuaries, *Sediment contamination, *Florida, Pensacola Bay, Ecological distribution, Species diversity, Seasonal variation, Anthracene, Chrysene, Fluoranthene, Fluorene, Pyrene, Phenanthrene, Polychaetes, Benthic fauna.

Seven sites in Pensacola Bay near an abandoned creosote plant were examined seasonally from June 1983 through June 1984 for possible contamination by creosote-constituent compounds and for the effects such contaminants may have on the distribution and abundance of benthic invertebrates. A similar site on the opposite side of the bay was used as a control. Analyses of streamflow and bay waters showed no trace of contamination at any of the sites, but streambed sediments were heavily contaminated. Compounds detected at the drainage stream and their concentrations in micrograms/kilogram of sediment, included anthracene (3,200), chrysene (7,100), fluoranthene (17,000), fluorene (3,100), phenanthrene (12,000), and pyrene (11,000). The data suggest that most compounds near the sediment surface are rapidly diluted and degraded in the estuarine environment. Analyses of sediment core segments, however, showed that some compounds have accumulated just below the surface, at depths of 8 to 13 cm and that below 13 cm, concentrations rapidly diminished. Compounds that commonly occurred in estuarine sediment included anthracene, pyrene, phenanthrene, fluoranthene, and benzo(k)fluoranthene. Rankings of total abundance and total numbers of benthic microinvertebrate species collected by season for each of the sites indicated no statistically significant difference between the nearshore sites proximal to the creosote plant and the controls. Composition of the communities at the various sites suggests that species residing in nearshore habitats are primarily controlled by physical events such as sediment resuspension, deposition, and seasonal influences. Cluster analysis of combined seasonal collections showed that the majority of nearshore sites proximal to the creosote plant, regardless of season, clustered together. These results, together with the results of bioaccumulation studies, suggest that benthic communities proximal to the creosote plant are influenced by the presence of contaminants. The major factor however, controlling the distribution of species, appears to be seasonal variation in association with invertebrate recruitment patterns. (See also W90-00022) (Lantz-PTT)
W90-00027

HYDROGEOLOGIC CONTROLS ON SOLUTE TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER.

Geological Survey, Boston, MA.
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IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p B7-B12, 6 fig, 3 ref.

Descriptors: *Wastewater pollution, *Geohydrology, *Solute transport, *Path of pollutants, *Groundwater pollution, Wastewater disposal, Aquifers, Fate of pollutants, Simulation analysis, Borehole geophysics, Data acquisition, Plumes, Cape Cod, Hydraulic conductivity, Model studies, Calibrations.

Treated sewage has been discharged to a sand and gravel outwash aquifer at Otis Air Base on Cape

Cod, since 1936, and has formed an extensive contaminant plume. Accurate simulation of the rate and three-dimensional direction of contaminant movement is needed to predict the fate of contaminants in the sewage plume. The path of the plume was simulated accurately because hydraulic heads calculated by the flow model matched the observed head distribution. However, the computed heads were relatively insensitive to aquifer hydraulic properties during flow-model calibration. Therefore, hydraulic conductivity, which directly affects the rate of contaminant movement, was not well quantified during calibration. An aquifer test was used to measure average hydraulic conductivity of the outwash. Borehole geophysical logs also may yield detailed information on physical characteristics of the outwash. Natural-gamma logs may correlate with hydraulic conductivity. Spacing of peaks on the logs is roughly equal to thickness of layers observed in test pits. Preliminary uncalibrated neutron logs suggest that the outwash porosity may vary only 3-5%. These logs, when calibrated against data from hydraulic tests of cores, should provide an indirect method of determining hydraulic conductivity and porosity. These data can then be applied to a three-dimensional flow model that will be the basis for simulations of the three-dimensional features of the plume. (See also W90-00022) (Lantz-PTT)
W90-00028

DESIGN AND IMPLEMENTATION OF A LARGE-SCALE NATURAL-GRADIENT TRACER TEST.
Geological Survey, Boston, MA.
S. P. Garbedian, D. R. LeBlanc, R. D. Quadri, K. M. Hess, and K. G. Stollenwerk.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p B13-B18, 4 fig, 4 ref.

Descriptors: *Experimental design, *Water table gradient, *Groundwater movement, *Path of pollutants, *Tracers, Field tests, Bromides, Lithium, Molybdenum, Geohydrology, Fluorides, Hydraulic conductivity, Observation wells, Spatial distribution, Porosity, Cape Cod.

A large-scale natural gradient tracer test that is in progress at a sewage contaminated site near Otis Air Base on Cape Cod, was designed to examine solute dispersion in a sand and gravel aquifer. Dispersion of solutes transported in aquifers has been found to differ from dispersion in laboratory column tests. Field studies have also indicated that dispersion is scale dependent; dispersivity increases with time or travel distance. Recent research has shown that: (1) the early dispersive process is significantly non-Fickian; (2) the mean transport process approaches Fickian conditions after an extended time; and (3) the asymptotic value of dispersivity is related to the statistical properties of the porous medium. The natural gradient tracer test was started in July 1985 with the pulse injection of four tracers into the outwash sand and gravel aquifer at an abandoned gravel pit near the site. The tracers include a conservative solute (bromide) and three nonconservative solutes (lithium, molybdenum, and fluoride). A network of observation wells was installed to define the water table altitude in the area of the tracer test. To date (October 1985), four rounds of sampling have been done to identify the spatial distribution of solutes in the tracer cloud. The average velocity of the bromide cloud, as indicated by peak concentration, is about 1.6 ft/d. This velocity is similar to a prediction of 1.5 ft/d based on estimates of hydraulic conductivity (380 ft/d), porosity (0.35), and water table gradient (0.0014) at the test site. The average direction of bromide movement also closely follows the projected flow path based on the water table configuration. Bromide concentrations are more dilute in fast moving zones at the leading edge of the tracer cloud than near the center of mass because of the effects of local longitudinal and transverse dispersion. (See also W90-00022) (Lantz-PTT)
W90-00029

BACTERIAL DISTRIBUTION AND TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Menlo Park, CA.
R. W. Harvey, and L. George.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p B25-B26, 3 ref.

Descriptors: *Groundwater movement, *Wastewater pollution, *Bacterial analysis, *Path of pollutants, *Distribution patterns, *Groundwater pollution, *Bacteria, Infiltration, Microbiological studies, Aquifers, Plumes, Population density, Cape Cod, Microscopic analysis, Tracers.

Bacterial abundance, particle/solution partitioning, and cell-size distribution were determined from microscopic analysis of groundwater and subsurface sediment-core samples taken from a sewage-contaminated aquifer on Cape Cod. Abundance of free-living (unattached) bacteria in the subsurface ranged from 1.03/ml immediately adjacent to the sewage disposal beds to 1.6/ml at a control site upgradient from the zone of contamination. Numbers of unattached bacteria at most sites varied little over a 2-year span; however, bacterial abundance along a vertical transect through contaminated groundwater varied up to threefold in < 1 m. Field evidence suggests that unattached bacteria may be transported through a substantial length of the contaminant plume. Although bacterial abundance in a zone 0.4 km to 2.4 km downgradient from the sewage disposal beds changed linearly with specific conductance of groundwater, the numbers of unattached bacteria closer than 0.4 km to the infiltration beds were many times higher than would be predicted from specific conductance values. Average size of unattached bacteria in contaminated groundwater increases from 0.50 micrometers (average cell length) at a distance of 0.01 km from the infiltration beds to 0.90 microm at a distance of 0.64 km downgradient. This is due to corresponding decreases in the relative abundance of small (< 0.4 um diameter) bacteria. The observation that larger bacteria are transported more readily than smaller bacteria in moving groundwater is consistent with subsurface transport studies done with nonendemic 'tracer' microorganisms. (See also W90-00022) (Lantz-PTT)
W90-00031

FATE OF AMMONIUM IN A SEWAGE-CONTAMINATED GROUND WATER.
Geological Survey, Denver, CO.
M. L. Ceazan, R. L. Smith, and E. M. Thurman.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p B29-B30, 7 ref.

Descriptors: *Wastewater pollution, *Fate of pollutants, *Groundwater pollution, *Ammonium, Nitrogen compounds, Nitrates, Aquifers, Microbiological studies, Adsorption, Infiltration, Nitrification.

The plume of sewage contaminated groundwater at the Otis Air Base site on Cape Cod, contained ammonium (NH4(+)) in high concentrations (7 to 10.7 mg N/L) within about 1,000 ft downgradient from the infiltration beds; however, NH4(+) was depleted (< 2 mg N/L) from 6,000 to 8,000 ft downgradient from the beds and absent beyond 8,000 ft. Conversely, nitrate (NO3(-)) was the predominant species of inorganic nitrogen from 6,000 ft to the toe of the plume (about 11,000 ft downgradient from the beds). In the zone of depleted NH4(+), NO3(-) levels were elevated (> 2 mg N/L) and dissolved oxygen (DO) was present. These results suggest that NH4(+) attenuation is due to nitrification or to differential rates of transport of NH4(+) and NO3(-) caused by sorption of NH4(+) on aquifer solids. To test these hypotheses, evidence for nitrification and sorption was obtained in laboratory studies conducted on aquifer material. The results of the study indicate that both microbiological and adsorption processes play a role in the transport and fate of NH4(+) in the aquifer. The relative importance of each, and the effect of sorption upon nitrification, remains to be determined. (See also W90-00022) (Lantz-PTT)
W90-00032

HYDROGEOLOGY AND PRELIMINARY REGIONAL FLOW MODELING AT THE BEMIDJI, MINNESOTA, RESEARCH SITE.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 2F.
W90-00034

INORGANIC GEOCHEMISTRY OF GROUND WATER AND AQUIFER MATRIX: FIRST-YEAR RESULTS.
Syracuse Univ., NY.
For primary bibliographic entry see Field 5C.
W90-00035

DISTRIBUTION OF GASES AND HYDROCARBON VAPORS IN THE UNSATURATED ZONE.
Geological Survey, St. Paul, MN.
M. F. Hult, and R. R. Grabbe.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C21-C25, 3 fig.

Descriptors: *Groundwater pollution, *Hydrocarbons, *Fate of pollutants, *Soil gases, *Aeration zone, *Oil pollution, *Path of pollutants, Volatile organic compounds, Diffusion, Methane, Alkanes, Aromatic compounds.

A spill of crude oil in August 1979 near Bemidji, MN, contaminated a glacial outwash aquifer. Crude oil is present as: (1) a separate fluid phase floating on the water table; (2) constituents dissolved in groundwater; and (3) vapors in the unsaturated zone. Field samples were collected during June-July 1984 and September-October 1985. The purpose of the first sampling was to qualitatively delineate the plume of contaminated groundwater by measuring the concentration of hydrocarbon vapors in the unsaturated zone. The second sampling provided quantitative data on individual organic compounds, oxygen, and carbon dioxide needed to determine chemical and microbial processes that affect contaminant movement and fate. Results of this study show that large quantities of volatile hydrocarbons move through the unsaturated zone by diffusion and are oxidized to CO2 and/or converted to methane. Alkanes predominate in the unsaturated zone, whereas aromatic compounds dominate the volatile fraction dissolved in the groundwater. (See also W90-00022) (Lantz-PTT)
W90-00036

MASS TRANSFER AT THE ALKANE WATER INTERFACE IN LABORATORY COLUMNS OF POROUS MEDIA.
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
H.-O. Pfannkuch, S. M. Nourse, and M. F. Hult.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C29-C32, 3 fig, 1 tab, 6 ref.

Descriptors: *Porous media, *Path of pollutants, *Oil pollution, *Mass transfer, *Alkanes, Groundwater movement, Flow velocity, Chemical reactions.

Preliminary results of laboratory column experiments simulating mass transfer of liquid hydrocarbons to groundwater indicate that the transfer coefficient may be velocity dependent at typical groundwater flow velocities. The transfer coefficient and the coefficient's dependence is strongly controlled by the aqueous solubility of the hydrocarbon. Measured coefficients are lower than values reported in the literature for dispersed, fixed-bed reactors. (See also W90-00022) (Lantz-PTT)

W90-00037

MICROBIAL DEGRADATION OF CRUDE OIL AND SOME MODEL HYDROCARBONS.
Bemidji State Univ., MN. Center for Environmental Studies.
F. H. Chang, N. N. Noben, D. Brand, and M. F. Hult.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C33-C42, 5 fig, 5 tab, 4 ref.

Descriptors: *Biodegradation, *Microbial degradation, *Oil pollution, *Hydrocarbons, *Fate of pollutants, Carbon dioxide, Microbiological studies, Cyclohexane, Hexadecane, Naphthalene, Phenanthrene, Carbon dioxide, Aerobic conditions, Anaerobic conditions.

Research on microbial degradation of crude oil in the shallow subsurface at a spill site near Bemidji, MN, began in 1983. The rate and extent of crude oil and model hydrocarbon biodegradation by the indigenous microbial community was measured in the laboratory at several concentrations of inorganic nutrients, conditions of oxygen availability, incubation temperatures, and incubation time. Significant crude oil and model hydrocarbon degradative potential was observed in tests that used mixed indigenous microbial populations. The degradative potential of each hydrocarbon varied with the numbers and types of microorganisms present in incubated sediment samples. Metabolic fate studies indicated that the aliphatic hydrocarbons cyclohexane and hexadecane, and the two-ring aromatic hydrocarbon, naphthalene, were subject to removal by microorganisms. The rate of microbial degradation was less for a three-ring aromatic compound, phenanthrene. In the laboratory experiments, degradation rates under aerobic conditions are nearly an order of magnitude greater than under anaerobic conditions. Dissolved oxygen in uncontaminated groundwater upgradient from the contaminant plume typically contains 1 to 3 mg/L, which suggests that sufficient oxygen is available, at least at the periphery of the contaminant plume, for microbial degradation. Crude petroleum and model-hydrocarbon biodegradation was stimulated by an increase in temperature, inorganic nutrient concentration, and oxygen availability, as indicated by increases in CO2 production, O2 uptake, and heterotrophic microbial counts. (See also W90-00022) (Lantz-PTT)
W90-00038

MINE-WATER DISCHARGE, METAL LOADING, AND CHEMICAL REACTIONS.
Geological Survey, Oklahoma City, OK.
D. L. Parkhurst.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p D5-D9, 3 fig, 4 ref.

Descriptors: *Mine drainage, *Pollution load, *Water pollution sources, *Heavy metals, Lead, Zinc, Sulfides, Carbonate rocks, Chert, Dolomite, Calcite, Kansas, Chemical reactions, Chemical interactions, Tar Creek, Oklahoma, Discharge measurement.

Lead and zinc ores were mined from the Picher Field in northeastern Oklahoma and southeastern Kansas from the turn of the 20th century until the 1960's. Sphalerite and galena were the major sulfide ores found in this carbonate-rock mining district. In addition, the mineralization produced chert, dolomite, and calcite. Mine dewatering was stopped after mining ceased and the mines subsequently filled with water. About 1980, mine water began to discharge from a few mine shafts and air shafts at land-surface altitudes of about 800 ft in the Tar Creek basin. Mine water has discharged intermittently since that time. Estimates of the volume of water and the metal loading of Tar Creek due to mine water discharge from January 1984 through March 1985, are provided in this paper. Using two rating methods, the mean-daily discharge of water from the mines from January 1984 through March 1985 were determined. The mean-daily discharge ranged from < 1.5 to 225 cu ft/sec. The total volume of water discharged during the period was 5,600 acre-ft. The annual volume of mine discharge is estimated to be 3,400 acre-ft/yr. To use all available data for the 15 months, the data were averaged by month of the year when data existed, and summed for all months to determine the value of 3,400 acre-ft/yr. Chemical analyses of water samples from mine shafts, air shafts, and discharge points have been used to postulate the chemical reactions that produced to the chemical composition of the water within the mines. This water was found to be the result of: (1) an oxidizing environment when the mines were open to the atmosphere during mining or as the mines were filling; and (2) a reducing environment when the mines filled with water and atmospheric contact was negligible. (See also W90-00022) (Lantz-PTT)
W90-00039

DISTRIBUTION OF MICROORGANISMS AND SELECTED METALS IN MINE DRAINAGE, STREAM WATER, AND SEDIMENT.
Geological Survey, Denver, CO.
K. S. Smith, L. H. Filipek, D. M. Updegraff, and C. S. E. Papp.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p D11-D15, 3 fig, 6 ref.

Descriptors: *Path of pollutants, *Stream pollution, *Fate of pollutants, *Microorganisms, *Mine drainage, *Heavy metals, *Sediment contamination, Microbiological studies, Biomass, Tar Creek, Zinc, Cadmium, Clays, Aluminum, Chromium, Cobalt, Nickel, Manganese, Iron, Adenosine triphosphate, Lead, Distribution patterns.

Tar Creek is the major stream draining a lead-zinc mining area in northeastern Oklahoma and southeastern Kansas. Since 1980, water from abandoned and flooding mine workings near Picher, OK, has been discharging from several boreholes and shafts. The discharge water, which is high in Cd, Fe, Pb, Zn, and other metals, flows into Tar Creek. The objective of the initial studies was to survey the microbial population and chemical characteristics of water and sediment in Tar Creek and the mine-discharge areas. Some Tar Creek composite sediment samples have been examined by a selective chemical extraction procedure to determine the mode of occurrence and variation of trace metals within the sediments. Results of chemical analyses reveal several general trends and associations among elements in the Tar Creek sediments: (1) The sediment consists of chat (mine and mill-waste materials, predominantly chert) mixed with clays and other material. The background site and the farthest downstream site (TC6) contain seven and three times more Al, respectively, than the other site. (2) Although total Cr, Co, Ni, Mn, and Fe appear to be diluted by the presence of chat in the sediment, the HCl-extractable concentrations of these elements are correlated with each other and increase to well above background levels at the farthest downstream site. (3) Organic C and total S concentrations decreased downstream from site. (4) The partitioning patterns of Zn and Cd among the extractions are almost identical. The results suggest that most of the Zn and Cd are present as detrital sphalerite, with some minor carbonate phases. (5) The Pb results area more difficult to interpret but suggest that much of the Pb is detrital galena. Tar Creek aerobic microbial enumerations on nutrient agar and minimal yeast-extract agar, indicate that many microorganisms may use oxidizable inorganic compounds as an energy source. Biomass determinations indicate that ATP varies with sample location. (See also W90-00022) (Lantz-PTT)
W90-00040

NEUTRALIZATION OF ACIDIC GROUND WATER IN EASTERN ARIZONA.
Geological Survey, Denver, CO.
K. G. Stollenwerk.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p E7-E8, 1 tab, 4 ref.

Descriptors: *Fate of pollutants, *Acid mine drainage, *Sulfates, *Groundwater quality, *Neutralization, *Arizona, *Acidic water, *Geochemistry, Chemical reactions, Chemical interactions, Calcium, Sulfates, Heavy metals, Iron, Aluminum, Cobalt, Copper, Nickel, Zinc, Cadmium, Silicates, Carbonates.

Sulfate is the major constituent of the contaminated groundwater at the Miami Wash-Pinal Creek valley site. The solubility product is exceeded for the following minerals in the most contaminated part of the aquifer: alunite, jurbanite, jarosite, gypsum, chalcedony, and pryophyllite. Constituents of the contaminated groundwater that may adversely affect the environment, in addition to low pH, include high total dissolved solids, Al, Cu, Co, Fe, Ni, and Zn. Several reactions are important for removing these constituents from solution. The following three types of reaction are important for neutralization of H(+): (1) reaction with carbonate minerals in alluvium; (2) reaction with silicate minerals; and (3) reaction with bicarbonate in uncontaminated groundwater. Neutralization of H(+) by carbonate minerals and HCO3(-) is relatively fast. Reaction of H(+) with silicate minerals proceeds at a much slower rate. Because contaminated groundwater contains high concentrations of iron, reactions involving iron have a significant effect on the composition of groundwater in the study area. The original acidity of the groundwater is a result of sulfide mineral oxidation. After groundwater leaves the sulfide-rich source area, oxidation of Fe(+) is an additional, relatively continuous source of H(+). Sulfate and iron form about 775% of the dissolved solids in contaminated groundwater. Gypsum crystals are abundant in alluvium collected from the contaminated part of the aquifer. Aluminum sulfate minerals such as jurbanite and alunite control the concentration of Al in contaminated groundwater. As pH increases and SO4 decreases, kaolinite and gibbsite become important in limiting Al in solution. Cu, Co, Ni, Zn, and Cd are undersaturated with respect to the mineral phases tested. Adsorption by, and coprecipitation with, oxyhydroxides are two likely controls on their concentration in contaminated groundwater. (See also W90-00022) (Lantz-PTT)
W90-00043

ARSENIC SPECIES IN GROUND WATER AND PORE WATERS IN STREAM SEDIMENTS AFFECTED BY MINE DRAINAGE IN MONTANA AND COLORADO.
Geological Survey, Denver, CO.
W. H. Ficklin, and J. L. Ryder.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p E9-E11, 2 fig, 4 ref.

Descriptors: *Groundwater, *Water pollution sources, *Acid mine drainage, *Interstitial water, *Arsenic, *Geochemistry, *Path of pollutants, Montana, Colorado, Chemical analysis, Chemical interactions, Iron, Chemical reactions, Stream sediments, Microbial degradation, Chemical speciation, Hydroelectric plants, Bottom sediments, Groundwater pollution, Adsorption, Dam effects, Oxidation-reduction potential, Minerals, Mine wastes, Well water, Chemical precipitation, Hydrogen ion concentration.

Stream sediments have accumulated immediately upstream of a small hydroelectric dam on the Clark Fork River at the confluence of the Clark Fork and Blackfoot Rivers, MT. The small town of Milltown lies immediately across Interstate Highway 90 from the accumulated sediments. Arsenic (0.6 mg/L) was found in a sample of well water from a Milltown water supply; the source of the arsenic is the accumulated sediments in the reservoir upstream of the dam. The dissolution of the arsenic from these sediments into the ground-

water provides an ideal situation for the study of the mobility and stability of arsenic in the aqueous environment. In 1983, 20 groundwater samples from wells placed in the accumulated sediment were analyzed for total arsenic, As(III), As(V), and the two anticipated methylated As compounds. No methylated As compounds were detected. As(III) was the most abundant species, but As(V) was present in all but one sample. As occurs in the pore water at the same depth at which Fe concentrations increase. One of the steps in the sequence of microbially mediated processes in aquatic systems is the reduction of Fe(III) to Fe(II). When Fe is reduced, adsorbed As is released. The released As may be partly reduced to As(III), assuming that all released As was originally present as As(V). The concentration of each species may be controlled by the redox potential of the system. As occurs in several types of mineral deposits and also in acid mine waters. The As in the Milltown sediments may be an accumulation of products from acid mine drainage, adsorption of As by Fe-hydroxides, and unoxidized mine tailings. Similar acid mine drainages occur in the Colorado mineral belt. Acid mine waters precipitate Fe compounds. If the pH of the water is > 3.5, the precipitated Fe compounds immediately beneath the water contain a mixture of As(III) and As(V) when the precipitate is dissolved in 0.2M ammonium oxalate/oxalic buffer. Bottom sediment samples collected from Clear Creek contained no detectable methylarsonate or dimethylarsenite. (See also W90-00022) (Lantz-PTT)
W90-00044

HYDROGEOCHEMISTRY OF URANIUM AND ASSOCIATED ELEMENTS AT ABANDONED URANIUM MINES IN WESTERN NORTH DAKOTA.
Geological Survey, Bismarck, ND.
R. L. Houghton, R. L. Hall, J. D. Unseth, J. D. Wald, and G. S. Anderson.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p E19-E22, 2 fig, 1 tab, 3 ref.

Descriptors: *Water chemistry, *Mine wastes, *Radioactive wastes, *Uranium, *Geochemistry, *Mine drainage, *Water pollution treatment, *Groundwater pollution, *Waste disposal, *North Dakota, *Cleanup operations, Water pollution control, Radioactivity, Radium, Arsenic, Molybdenum, Selenium, Cadmium.

Between 11955 and 1967, approximately 590,000 lb of uranium oxide were recovered from 95,000 tons of lignite in at least 16 pits in western North Dakota. The overburden was stripped, and the lignite was burned in pit bottoms or nearby kilns to concentrate the uranium in its ash by a factor of about 10. Because uranium salts in the overburden generally were not recovered during mining, spoils piles at abandoned mine sites have surface gamma-ray exposure levels as high as 500 microroentgens/hr, approximately 30 times local background levels. Infiltrating water leaches spoils and residual ash and introduces U and associated elements such as Ra, As, Mo, and Se to water in the lignite aquifers or exposed in the pits. Aquifer and pit water have U concentrations ranging from 12 to 19,000 mg/L and companying 226-Ra concentrations ranging from 1 to 360 picoCuries/L (pCi/L). Groundwater in mine areas also commonly contains concentrations of As, Cd, Mn, and Hg in excess of Federal drinking water standards. A pilot reclamation project was implemented at one abandoned pit 6 miles northwest of Belfield, ND, during the summer of 1985. Basically, the reclamation involved the selective replacement of spoils into the pit from which they had been removed. Replaced spoils of high radioactivity and specific conductance also were capped with clay from the base of the pit, and the surface topography was mounded to minimize infiltration that might introduce radioactive and other soluble salts into the aquifer. A minimum of 4 ft of less contaminated spoils and topsoil were spread above the clay cap to minimize post-reclamation surface-radiation levels. Similarly, spoils with specific conductances > 5,000 microSiemens/cm were replaced at least 8 ft below the post-reclamation land surface to promote revegetation but above the water table to prevent the movement of dissolved solids to the aquifer. (See also W90-00022) (Lantz-PTT)
W90-00046

PROGRAM OVERVIEW AND SELECTED PAPERS FROM THE TOXIC-WASTE PROGRAM TECHNICAL MEETING: TUCSON, ARIZONA, MARCH 20-22, 1984.
Geological Survey, Reston, VA.
Available from the National Technical Information Service, Springfield, Virginia 22161. USGS Open-File Report 324, 1987. 116p. Edited by Stephen E. Ragone and Dennis J. Sulam.

Descriptors: *Path of pollutants, *Waste disposal, *Groundwater pollution, *Toxic wastes,*Hazardous wastes, *Conferences, Adsorption, Geochemistry, Geohydrology, Organic compounds, Disposal sites, Phenols, Model studies, Aquifers, Information exchange.

The US Geological Survey's (USGS) Program on Toxic Waste--Ground-Water Contamination (the Toxic Waste Program) was begun in fiscal year 1982 to coordinate and support Geological Survey projects and research relating to toxic waste contamination of aquifers. The program supports several types of studies which range from basic research to applied field studies. Although many of these studies are conducted independently by Geological Survey scientists, it is the intent of the Toxic Waste Program to enable researchers in USGS and in other Federal agencies and universities, to share the information. One approach is to encourage collaboration at the field sites. A second way in which the Toxic Waste Program makes the information from these studies accessible to the technical community is through the publication of reports. This volume describes the Toxic Waste Program and presents 10 of the papers that were given at the 1984 meeting in Tucson, AZ. It is the fourth volume to be issued in this series. Chapter headings are: The Role of Geochemical Processes in Hazardous Waste Studies; An Overview of Organic Compounds in Ground Water; The Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites; Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils; Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities; Modeling Sorptive Processes in Laboratory Columns; Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California; Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer near Telluride, Colorado; Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol; and The Role of Complexation and Adsorption Processes in Toxic Metal Transport. (See W90-00053 thru W90-00062) (Lantz-PTT)
W90-00052

ROLE OF GEOCHEMICAL PROCESSES IN HAZARDOUS-WASTE STUDIES.
Geological Survey, Columbia, SC. Water Resources Div.
F. H. Chappelle.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 9-19, 2 fig, 14 ref.

Descriptors: *Geochemistry, *Hazardous wastes, *Path of pollutants, *Waste disposal, Chemical reactions, Solute transport, Metals.

An important aspect of hazardous waste studies is evaluating the mobility of waste derivatives in the hydrosphere. Several kinds of geochemical techniques are currently available that may aid such evaluations. These include mass balance, chemical equilibria, and chemical kinetic calculations. Depending on the type of problem and on the kinds of information available, evaluations of waste mobility may range from quantitative to qualitative. In all cases, however, such evaluations require an explicit understanding of the geochemical processes that affect the waste materials. This paper presents a series of idealized examples to illustrate how geochemical techniques may be applied to waste mobility problems. These examples include: (1) a formulation of reactive solute transport in terms of a boundary value problem; (2) a demonstration of how equilibrium speciation calculations can be applied to complex-forming metals; (3) an evaluation of the solubility of metal-oxide compounds in aqueous solution. (See also W90-00052) (Author's abstract)
W90-00053

OVERVIEW OF ORGANIC COMPOUNDS IN GROUND WATER.
Geological Survey, Reston, VA. Water Resources Div.
A. C. Sigleo.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 21-36, 5 fig, 5 tab, 41 ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Groundwater pollution, *Water pollution sources, *Path of pollutants, Dispersion, Hydrolysis, Sorption, Biodegradation, Synthetic compounds.

The majority of organic chemicals in groundwater can be grouped into two major categories: (1) biochemicals--the natural products of biological processes (free volatile fatty acids, volatile amines, and alcohol), and (2) synthetic organic chemicals derived from a variety of manmade sources. The manmade source include landfills, industrial wastes, mining activities, sewage, and agriculture. The transport and fate of organic pollutants in groundwater influenced by the processes of dispersion, chemical hydrolysis, sorption/desorption, and biological degradation. Despite the complexity of these processes, progress in the understanding of the transport and fate of organic pollutants continues, as indicated by a series of examples in the text. (See also W90-00052) (Author's abstract)
W90-00054

CAPACITIES AND MECHANISMS OF SORPTION OF ORGANIC COMPOUNDS BY WATER-SATURATED AND UNSATURATED SOILS.
Geological Survey, Lakewood, CO. Water Resources Div.
C. T. Chiou.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 65-74, 4 fig, 13 ref.

Descriptors: *Sorption, *Organic compounds, *Aeration zone, *Soil water pollution, *Groundwater pollution, *Path of pollutants, Soil contamination, Parathion, Pesticides, Lindane, Benzene, Hexane, Chemical reactions, Soil water, Adsorption, Soil saturation.

To characterize the transport of organic contaminants through water saturated and unsaturated zones, the sorptive behavior of organic compounds from aqueous and organic solutions and from vapor phase was analyzed in terms of soil composition, effect of solvent polarity, and soil water content. Characteristic differences in soil sorption of parathion an lindane from aqueous and hexane solutions, and of benzene and m-dichlorobenzene from water and from vapor phase at different humidities, are illustrated and rationalized. For water saturated soils, the soil uptake is determined primarily by chemical partition, rather than adsorption, into the soil organic phase, in keeping with thermodynamic criteria. Adsorption by soil minerals is relatively insignificant with wet soils, presumably because water is preferentially adsorbed through its strong dipole interactions with soil minerals. By contrast, the soil uptake from hexane and from vapor phase at low soil moisture content is effected mainly through adsorption by soil minerals, as supported by data characteristic of adsorption phenomena. The capacity of uptake of unsaturated soil is markedly greater than the ca-

pacity of saturated soil. (See also W90-00052) (Lantz-PTT)
W90-00056

MODELING SORPTIVE PROCESSES IN LABORATORY COLUMNS.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W90-00058

ADSORPTION AND DESORPTION OF HEXAVALENT CHROMIUM IN AN ALLUVIAL AQUIFER NEAR TELLURIDE, COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
K. G. Stollenwerk.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 97-100, 2 fig, 4 ref.

Descriptors: *Sorption, *Adsorption, *Chromium, *Alluvial aquifers, *Path of pollutants, *Colorado, *Groundwater pollution, Desorption, Fate of pollutants, Chemical reactions, Plumes, Alluvium.

An evaluation of reactions between alluvium and hexavalent chromium Cr(IV) was conducted to determine the mechanisms responsible for these reactions. This paper discusses results of a laboratory investigation. One significant result indicates that desorption of Cr(VI) from alluvium occurs after the contaminated plume has passed. Initial desorption of Cr(VI) is rapid; followed by a steady decrease. Adsorption, it was found, of Cr(VI) is by specific and nonspecific mechanisms. Cr(VI) adsorbed by nonspecific processes is desorbed by chromium-free groundwater. Stronger bonds formed between Cr(VI) and alluvium during specific adsorption result in slow release of this fraction; thus, adsorbed Cr(VI) will serve as a secondary source of contamination long after the original plume has passed. (See also W90-00052) (Lantz-PTT)
W90-00060

EFFECTS OF PENTACHLOROPHENOL ON THE METHANOGENIC FERMENTATION OF PHENOL.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W90-00061

ROLE OF COMPLEXATION AND ADSORPTION PROCESSES IN TOXIC METAL TRANSPORT.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. A. Davis, and C. C. Fuller.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 107-116, 5 fig, 2 tab, 4 ref.

Descriptors: *Metal complexes, *Toxicity, *Toxic wastes, *Chemical reactions, *Path of pollutants, *Metals, *Adsorption, Cadmium, Field tests, Bromine, Chlorine, Groundwater, Tracers, Observation wells, Solute transport, Chelating agents.

A detailed laboratory study of cadmium uptake onto a calcareous, sandy aquifer material is being conducted to elucidate the mechanisms of adsorption and the role of specific mineral phases. The study has shown the importance of aqueous speciation on the adsorption behavior of cadmium, using EDTA as a strong chelating agent to compete with surface binding. Kinetic studies speculate that: (1) clean quartz adsorbs Cd(2+) too weakly to account for the behavior observed for the rapid uptake step on the sand; (2) a magnetic fraction that contained magnetite and some hematite was separated from the sand--this fraction adsorbed very little Cd initially, but may be significant in the slow uptake of Cd(2+); (3) reagent-grade calcite adsorbs Cd(2+) significantly both through rapid initial uptake and continued uptake for up to 2 days. However, the pH dependence Cd(2+) adsorption on calcite is quite different (decreasing Cd(2+) with increasing pH) than that observed for the sand. Dolomite and other slow dissolving carbonates are present in the sand. In a field experiment, 500 L of groundwater were injected in the aquifer after addition of Cl(-)(320 mg/L), Br(-) (61 mg/L), CdEDTA (1.0 nanomol), CrO4(2-) (1.0 nanomol), and excess EDTA (8.0 nanomol). Two millicuries (mCi) of 109-Cd and five mCi of 51-Cr were also injected as analytical tracers for the Cd and Cr. Observation wells were drilled in a rectangular grid and spaced about 0.5 m apart near the injection well and 1 m apart farther away. To date, the only observation is that the center of the 109-Cd activity appears to be moving at approximately the same speed as the nonreactive solutes (Cl(-) and Br(-)). The 51-Cr data have not been carefully analyzed yet, but it appears that Cr(VI) is weakly retarded. (See also W90-00052) (Lantz-PTT)
W90-00062

ACID RAIN 1986: A HANDBOOK FOR STATES AND PROVINCES.
Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. 609p.

Descriptors: *Air pollution effects, *Handbooks, *Acid rain, *Water pollution sources, *Regulations, *Canada, Water pollution control, Research priorities, Conferences, Information exchange, Environmental policy.

Representatives of state agencies and provincial governments, together with resource persons, attended this second international Wingspread Conference on Acid Deposition, September 1986, assembled to update knowledge in three major areas on acid deposition: research, information and policy at levels ranging from the local, state and provincial to the national and international. It was the first such conference held specifically to bring officials together from both the United States and Canada. Participants agreed that bilateral efforts to protect the environment in North America should take full account of extensive monitoring and research results in Europe, and that international exchange of information in this area should be encouraged. The 1986 Steering Committee recommended work group assignments to bring forth ideas and suggestions to provide a basis for future meetings. The work groups considered the following topics: cooperative research, information, control strategies, legislation, and policy. Following individual state and provincial presentations, the findings of the work group were summarized as: the conference was concerned with the solution(s) rather than the problem; this issue of 'acid rain' is expanding to include other airborne pollutants; this conference provided an opportunity to expand the network of involved individuals concerned with air quality; researchers now have a broader picture of state-province activities and views; and at this time, four states have laws relating to Acid Rain--New York, Wisconsin, Minnesota, and Massachusetts. (See W90-00064 thru W90-00076) (Lantz-PTT)
W90-00063

POLLUTANTS IN THE AIR AND ACIDS IN THE RAIN: INFLUENCES ON OUR NATURAL ENVIRONMENT AND A CHALLENGE FOR EVERY INDUSTRIAL SOCIETY.
California Univ., Berkeley. Dept. of Forestry and Resources Management.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 19-50, 2 fig, 3 tab, 25 ref.

Descriptors: *Environmental effects, *Industrial development, *Social aspects, *Air pollution, *Water pollution effects, *Water pollution sources, *Acid rain, *Acid rain effects, Ozone, Public health, Acidification, Sulfur dioxide, Nitrogen oxides, Heavy metals, Electric power production, Volatile organic compounds, Air pollution effects.

The largest of all human influences on the chemical climate result from combustion of fossil fuels, urban development, and clearing of land by burning of natural vegetation. These activities include: generation of electricity; refining and use of petroleum and petrochemicals; industrial processes of many sorts; use of transportation vehicles; and incineration and decomposition of sanitary and solid wastes; agricultural and silvicultural operations involving plowing, cultivating, spraying, disposal of plant and animal wastes, and burning of farm and forest residues. The pollutants constituting acid rain, of major concern, are: sulfur dioxide (SO2), nitrogen oxides (NOx), heavy metals such as Pb, Cd, Ni, and Hg, volatile organic compounds (VOCs), particulate matter (PM), and ozone (O3). The major effects of air pollution on society are: (1) effects on human health due to inhalation of airborne chemicals; (2) effects on human health due to atmospheric deposition or leaching and later ingestion of airborne or soilborne chemicals via drinking water, fish or other food products; (3) damage to engineering materials, statuary, monuments, and other cultural resources; (4) increased haze in the atmosphere; (5) acidification of lakes, streams, groundwaters, and soils; (6) fumigation of crops and forests near point sources of pollutants; (7) regional changes in the health and productivity of forests; and (8) fertilization of crops, forests, and surface waters. Sulfur dioxide emissions are involved in all eight effects. Nitrogen oxides or their photochemical derivatives are involved in seven of the eight effects. Volatile organic compounds or their photochemical derivatives such as O3 are involved in five of the eight effects. All three of these primary pollutants (SO2, NOx, and VOC) are produced during combustion of fossil fuels in power plants, metal smelters, transportation vehicles, and other industrial, commercial and domestic uses of energy. Sulfur dioxide, NOx, and VOC are also the most important chemical precursors of photochemical oxidants, acid deposition, atmospheric haze, and certain types of particulate matter which have a wide range of detrimental effects on society. (See also W90-00063) (Lantz-PTT)
W90-00064

ACID DEPOSITION: RESEARCH, INFORMATION, POLICY: A COLLOQUIUM. THE ROLE OF RESEARCH IN POLICY DEVELOPMENT: AN INDUSTRIAL PERSPECTIVE.
B. B. Stout.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 87-93.

Descriptors: *Water pollution control, *Air pollution control, *Acid rain, *Management planning, *Policy making, Forests, Research priorities, Air pollution, Water pollution effects.

The role of research in policy development is as difficult to assess as the role of air pollutants on forest productivity. In the case of air quality and forest health the leaders of the forest products industry in this country were so uncertain about the long-term effects of air quality on the productivity of forests that they initiated the Air Quality/Forest Health Investigative Program. To date, there is not a panic situation, such that forests are subjected to levels of pollutants comparable to point sources in this country or some of the European forests on a regional basis. There is still time to get the level of probability high enough so that there will be a comfortable, sure feeling in all sectors that the policies that are adopted will result in the wisest use of all resource--social, biological and financial. (See also W90-00063) (Lantz-PTT)
W90-00067

ACID DEPOSITION RESEARCH AND POLICY.
Kentucky Energy Cabinet, Lexington. Dept. for Energy Research and Development.
G. P. Gibian.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 133-143, 3 fig, append.

Descriptors: *Water pollution control, *Air pollution control, *Policy making, *Water pollution control, *Research priorities, *Kentucky, *Acid rain, Industrial plants, Air pollution, Coal, Air pollution control, Coal gasification, Technology, Energy, Fluidized bed process.

The Kentucky Energy Cabinet (KEC) currently sponsors research in Kentucky involving precipitation monitoring, effects on surface waters and stone, and atmospheric processes. Kentucky believes a preferred approach is development, demonstration, and utilization of advanced clean coal technologies for new and retrofit applications. Retrofit technologies could be demonstrated at plants thought to contribute to deposition in sensitive areas; this would provide some immediate relief while the process of replacing higher-emitting plants with new plants utilizing advanced technologies runs its course. Retrofitting a plant with today's advanced technology would bring emission rates down to somewhere between 0.6 and 1.2 pounds of sulfur dioxide per million Btu. By comparison, the demonstration integrated coal-gasification, combined-cycle plant at Coolwater emits around 0.03 pounds per million Btu; twenty to forty such plants could be operated and only emit as much as one plant retrofitted with today's technology. It would appear much more desirable to replace or retrofit plants with the new generation of technologies than to lock plants into the soon-to-be archaic technologies of today. Kentucky has invested heavily in its approach of clean coal technology. Since 1974, Kentucky has invested over $100 million to develop, demonstrate and commercialize new technologies which will utilize coal more efficiently and with less emissions; this includes $10 million in the 160 MW demonstration Atmospheric Fluidized Bed Combustion unit at Tennessee Valley Authority's plant in Kentucky. (See also W90-00063) (Lantz-PTT)
W90-00069

ACID DEPOSITION PROGRAM: SCOPE OF WORK.
Virginia State Air Pollution Control Board, Richmond.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 324-345.

Descriptors: *Air pollution control, *Acid rain, *Virginia, *Water pollution control, *Management planning, Water pollution sources, Acid rain effects, Path of pollutants, Air pollution, Research priorities, Planning, Chemistry of precipitation, Risk assessment, Air masses.

Acid deposition is a controversial, regional problem which requires a national solution. However, the Commonwealth of Virginia has developed a program to determine the source, distribution and effects of acid deposition in the state. The results of this program will be used to support federal action to reduce the problem in Virginia. Two long-range transport studies will investigate interstate transport of air pollution. The first will concentrate on the origins and movement of air masses into and out of the state. The second will focus on air mass movement associated with the chemistry of individual precipitation events. A comprehensive assessment of resources at risk will be coupled with a complete analysis of Virginia Acid Precipitation Network (VAPN) deposition and concentration patterns. All research proposals and findings will be evaluated by a group of nationally recognized scientists for scientific and technical merit. (See also W90-00063) (Lantz-PTT)
W90-00072

MERCURY LEVELS IN WALLEYES FROM WISCONSIN LAKES OF DIFFERENT WATER AND SEDIMENT CHEMISTRY CHARACTERISTICS.
Wisconsin Dept. of Natural Resources, Madison. Water Resources Research Section.
R. C. Lathrop, K. C. Noonan, P. M. Guenther, T. L. Brasino, and P. W. Rasmussen.
Wisconsin Department of Natural Resources, Madison, WI. Technical Bulletin No. 163, 1989. 40p, 5 fig, 27 tab, 67 ref, append.

Descriptors: *Path of pollutants, *Acidity, *Bioaccumulation, *Wisconsin, *Acid rain effects, *Walleye, *Mercury, *Lake sediments, Chemical analysis, Hydrogen ion concentration, Alkalinity, Calcium, Conductivity, Chlorophyll a, Sediment contamination, Fish, Fish physiology.

Forty-three lakes throughout Wisconsin were sampled in 1985-86 to determine the water and sediment chemistry characteristics that were associated with elevated concentrations of mercury in walleyes. Mean mercury concentrations for each of three different length classes of walleyes increased as the parameters lake pH, alkalinity, calcium, conductivity, or chlorophyll-a decreased. Low values for these parameters characterized most lakes in northern Wisconsin. Mean mercury concentrations exceeded the Wisconsin health standard of 0.5 micrograms (ug) Hg/g wet weight of fish for all walleye length classes in lakes with pH values < 6.0, for walleyes > or = to 15.0 inches in lakes with pH 6.0-6.9, and for walleyes > or = to 20.0 in. in all lake pH categories. Apparently the older, larger walleyes in hard water as well as soft water lakes can accumulate enough mercury to warrant concern. Sediment mercury concentrations were generally < or = 0.02 ug/g dry weight for all study lakes, but sediment mercury and organic matter were higher in lakes with pH values < 7.0 than in lakes with pH > or = 7.0. Models were developed and tested to predict mercury concentrations in a 17-in. walleye for each lake. The best model derived from the study and tested on an independent dataset used alkalinity and calcium as independent variables. Clearly, walleyes from soft water, poorly buffered, low pH lakes have the highest concentrations of mercury, but the reasons for these higher concentrations require further study. (Author's abstract)
W90-00078

INDIANA WATER QUALITY 1987: MONITOR STATION RECORDS, RIVERS AND STREAM.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN. Indiana Department of Environmental Management, Indianapolis, Indiana.

Descriptors: *Data collections, *Water quality, *Indiana, Chemical analysis, Bacterial analysis, Plankton, Coliforms, Inorganic compounds.

This is the thirtieth annual water quality report on the major surface waters of Indiana. In April 1957, the Division of Sanitary Engineering, Indiana State Board of Health, established 49 sites for the bi-weekly collection of samples for physical, chemical, and bacteriological analyses, and 10 of the stations were sampled for radiological analyses. Various changes and improvements have been made since the program was established in 1957. On April 1, 1986, the Indiana Department of Environmental Management assumed this program's duties. This report details the analyses conducted on the 105 stations that were included in the total 1987 program. Physical, chemical, and bacteriological analyses were made on samples collected from all 105 of these stations and plankton analyses from 40. Station records for both chemical (alkalinity, ammonia, As, biochemical oxygen demand, Cd, Ca, chemical oxygen demand, chloride, Cr, Cu, CN, dissolved oxygen, F, hardness, Fe, Pb, Mg, Mn, Hg, Ni, nitrates, nitrites, oil, pH, phenols, P, phthalates, polychlorinated biphenyls, K, silica, Na, specific conductance, sulfates, suspended residue, total organic carbon, turbidity, and Zn) parameters, biological (fecal coliforms, coliforms, and fecal streptococci) parameters, and planktonic analyses, are presented. (Lantz-PTT)
W90-00079

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR PYRENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W90-00089

EFFECT OF THE ASARCO SMELTER SHUTDOWN ON THE ACIDITY OF RAINFALL IN THE PUGET SOUND AREA.
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
N. S. Laulainen, T. V. Larson, R. J. Vong, and W. H. Zoller.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011898. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA--15880, April 1988. 11p, 2 fig. DOE Contract DE-AC06-76RL0-1830.

Descriptors: *Washington, *Acid rain, *Puget Sound, *Industrial plants, *Water pollution sources, Sulfur dioxide, Copper, Statistical models, Sulfates.

The influence of the sulfur dioxide emissions from a large copper smelter in Tacoma, Washington, was studied by measuring the chemical composition of rainwater collected upwind and downwind of the source, before and after permanent model that accounted for variability associated with location of 25 sampling sites within three geographic regions, smelter operation, ten individual rain events observed over 2 years, and measurement uncertainty. After smelter closure, the upwind-downwind differences in mean hydrogen ion and excess sulfate ion concentrations within a 600 sq km region extending to 25 km downwind of the source had decreased significantly compared to the pre-closure value. No significant decreases in mean ion concentrations were observed farther downwind in the Seattle, urban area. During five events sampled prior to smelter closure, the authors estimate that an average of 1.7% (range 0.3 to 3.0%) of the sulfur dioxide emitted by the smelter was wet deposited as sulfate ions within a 3600 sq km area extending 60 km downwind of the source. (Author's abstract)
W90-00093

SEDIMENT-WATER INTERACTIONS AND CONTAMINANTS IN CORPS OF ENGINEERS RESERVOIR PROJECTS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, J. M. Brannon, A. L. Mills, and L. K. Blum.
Available from the National Technical Information Service, Springfield, VA 22161, ADA-211153. Price codes: A04 in paper copy, A01 in microfiche. Technical Report E-89-2, July 1989. Final Report. 47p, 1 fig, 1 tab, 135 ref.

Descriptors: *Sediments, *Literature review, *Water pollution sources, *Water pollution effects, *Reservoirs, Pesticides, Organic compounds, Hydrogen ion concentration, Heavy metals, Adsorption, Path of pollutants, Sediment contamination, Biodegradation, Acid rain, Research priorities.

Many Corps of Engineers (CE) reservoirs are experiencing problems resulting from the presence of contaminants in project waters and sediments. Organic contaminants of concern include the older pesticides (e.g., DDT) and their degradation products, phenols, miscellaneous toxics (priority pollutants), polychlorinated biphenyls (PCBs), and petroleum hydrocarbons. Among the metals of concern, iron and manganese occur commonly, as do cadmium, copper, lead, and mercury. The mechanisms by which iron and manganese move from sediments in the water column in reservoirs are well-established and do not require further investigation. Acid mine drainage, pH fluctuations, and acid rain occur over wide regions of the country. This is particularly true for reservoirs in the Midwest and Northeast, although the central South also has some problems. The principal difficulty in managing problems resulting from the presence of contaminants in CE reservoirs is the lack of a suitable means to quantify contaminant movement within the project. This report examines the literature on sediment-water interactions and contaminant processes with respect to the unique conditions present in reservoirs. Recommendations for future investigations are: (1) adsorption/desorption rates for the contaminants of concern; (2) the impact of sediment concentration on equilibrium

distribution coefficient and adsorption/desorption kinetics; (3) the effect of particle composition on contaminant adsorption/desorption; (4) the influence of site-specific conditions and environmental factors on contaminant-sediment-water interactions; and (5) the effect of microbial transformation reactions on the mobilization of contaminants of concern and establishment of ways to incorporate these reactions into methodologies for assessing contaminated sediments. (Lantz-PTT)
W90-00098

INDIANA WATER QUALITY 1986: MONITOR STATION RECORDS--RIVERS AND STREAMS.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN 46224.
For primary bibliographic entry see Field 2E.
W90-00127

ACID RAIN: DELAYS AND MANAGEMENT CHANGES IN THE FEDERAL RESEARCH PROGRAM.
General Accounting Office, Washington, DC. Resources, Community and Economic Development Div.
Available from the National Technical Information Service, Springfield, VA 22161, as N88-25988. Price codes: A04 in paper copy, A01 in microfiche. Report No. GAO/RCED-87-89, April 1987. 75p, 3 fig, 3 tab, 5 ref.

Descriptors: *Research priorities, *Acid rain, *Management planning, Water pollution sources, Policy making, Interagency cooperation, Air pollution, Dry deposition, Environmental effects.

In 1980 the Congress established a 10-year multiagency research program--the National Acid Precipitation Assessment Program (NAPAP)--to help resolve the scientific uncertainties associated with acid rain and determine if and how it should be controlled. Concerned about NAPAP's progress to date, the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, requested that General Accounting Office (GAO) review: the extent to which the NAPAP has conducted and issued assessments or analyses of its research; the impact that the September 1985 appointment of a director of research has had on NAPAP's operations; and the status of NAPAP's plans to address the research uncertainties associated with acid rain by 1990. NAPAP has yet to issue its first assessment report--originally scheduled for release in 1985 and now delayed until June 1987--because the new director of research has been extensively revising the document. However, NAPAP officials believe that by 1990, their ongoing research program will provide sufficient new information about the causes and effects of acid rain to serve as the basis for policy recommendations on acid rain controls. NAPAP officials believe that its ongoing research program will answer many key unknowns and provide sufficient new information by 1990 to serve as the basis for policy recommendations on acid rain controls. NAPAP is focusing its research on several areas, including: (1) validating regional air pollution models; (2) measuring dry deposition (deposition of gases and particles that occur apart from rain, snow, and fog); and (3) quantifying the effects of acid rain on lakes, forests, and man-made materials. (Lantz-PTT)
W90-00138

GROUND CONDUCTIVITY MEASUREMENTS ADJACENT TO THE KESTERSON PONDS 1, 2, AND 5.
Lawrence Berkeley Lab., CA. Earth Sciences Div.
For primary bibliographic entry see Field 2G.
W90-00139

GEOCHEMICAL INTERACTIONS OF HAZARDOUS WASTES WITH GEOLOGICAL FORMATIONS IN DEEP-WELL SYSTEMS.
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W90-00141

HISTORICAL AND FUTURE EMISSIONS OF ACIDIC DEPOSITION PRECURSORS FROM MAN-MADE SOURCES.
Argonne National Lab., IL. Energy and Environmental Systems Div.
M. Place' and D. G. Streets.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-010024. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-8806123--2, (1988). 4p. DOE Contract W-31-109-Eng-38.

Descriptors: *Air pollution, *Acid rain, *Water pollution sources, *History, Sulfur dioxide, Nitrogen compounds, Volatile organic compounds, Future planning, Projections.

Three pollutants--sulfur dioxide (SO2), nitrogen oxides (NOx) and volatile organic compounds (VOC)--have been targeted as the primary species involved in the atmospheric chemical reactions that produce acidic deposition. Emissions data for current man-made sources indicate that electric utility power plants, located primarily in the middle and northern parts of the eastern United States, are the primary source of emissions of SO2 and a major source of NOx. Estimated NOx emissions have shown a substantial net increase over the course of the twentieth century. In 1900, emissions of NOx are estimated to have been about 2 million tons. By 1940, they were about 7 million tons; and between 1940 and the late 1970's, NOx emissions are estimated to have increased three fold to about 21 million tons. Highway vehicles consume a large portion of total fuel in the United States and are a major source of NOx emissions. Emissions of VOC are more difficult to characterize and estimate than those of SO2 and NOx because of the wide diversity in the sources of VOC and the large number of individual compounds in this broad category. It is estimated that in 1980 almost 40% of total US emissions of VOC came from transportation activity; about 40% came from evaporative sources (the use of organic solvents and paints in industrial, commercial, and residential applications and the storage, handling and transfer of petroleum products); and slightly more than 10% came from combustion sources. Future emissions will depend on changes in the array of sources over time and the likely penetration and performance levels of new energy and emission-control technologies. This paper presents the results of a review of emission projections made by various models under a range of input assumptions. It was the finding of this review that, given the same or similar input parameters, all the models examined show approximately the same projected emission trends nationally. The differences in emission trends projected by the different simulation models with the same input assumptions were smaller than the differences caused by varying the assumptions within a single model. (Lantz-PTT)
W90-00151

GROUNDWATER PUMPING TESTS: DESIGN AND ANALYSIS.
For primary bibliographic entry see Field 2F.
W90-00159

ANALYTICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
For primary bibliographic entry see Field 2F.
W90-00162

NUMERICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
For primary bibliographic entry see Field 2F.
W90-00174

HAZARDOUS MATERIALS: MICROBIOLOGICAL DECOMPOSITION, JANUARY, 1978-AUGUST, 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W90-00178

TAILINGS FROM COAL MINING. WEATHERING AND SOLUTION PROCESSES IN THE TAILINGS AS ILLUSTRATED BY LYSIMETER EXPERIMENTS (DIE ABGANGE DES STEINKOHLENBERGBAUS. VERWITTERUNGS UND LOSUNGSVORGANGE IM BERGEMATERIAL, DARGESTELLT AN LYSIMETERVERSUCHEN).
Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Natur- und Geisteswissenschaften.
M. Schopel.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81524/GAR. Price codes: E99 in paper copy, A01 in microfiche. Feb 1985. 482p, 27 fig, 59 tab, 169 ref. English summary.

Descriptors: *Water pollution sources, *Acid mine water, *Spoil disposal, *Mine wastes, *Groundwater pollution, *Spoil banks, *Coal mining, Fly ash, Lysimeters, Sulfates, Drainage water, Bacterial degradation.

Drainage water from spoil banks and groundwater below the banks were sampled and analyzed. Bacterial degradation of sulfates was observed below the spoil banks. With filler materials, the volume and composition of the drainage water changed considerably. Sealing materials at the bottom of spoil banks must be water-permeable. Weathering and solution characteristics of fly ash from a coal power plant were determined in a lysimeter experiment. A detailed bibliography is presented. (Author's abstract)
W90-00180

HEAT AND MOISTURE LOSSES OF HEATED RIVERS (WAERME UND FEUCHTEABGABE AUFGEHEIZTER FLUESSE).
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
F. Gunneberg.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80224/GAR. Price codes: E07 in paper copy, A01 in microfiche. Report no. UBA-FB-81-122, Contract UFOPLAN-Nr. 1985. 30p, 20 fig, 7 ref. English summary.

Descriptors: *Water temperature, *Thermal properties, *Heat transfer, Wind, Equilibrium.

Heat and moisture looses were studied in the thermally polluted Moselle River. Two thermally insulated tanks with an area of 6 m (2) each floated in the Moselle, one having a water depth of 30 cm, the other 2 mm. As a result of their very different time constants, their temperature differed from the equilibrium temperature by different amounts, and the components of heat exchange were different. In this way the course of the temperature and its causality were to be followed in order to improve the determination of the wind function. The aim of the project was essentially not achieved. (Author's abstract)
W90-00182

IMPORT AND EXPORT OF ACID POLLUTION IN THE NETHERLANDS (IMPORT EN EXPORT VAN ZUUR IN NEDERLAND).
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman, E. Buijsman, A. Vermetten, H. M. Ten Brink, and R. J. Heijboer.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-149943/GAR. Price codes: E04 in paper copy, A01 in microfiche. Report no.IMOU-R-86-10. Sept 1986. 96p, 20 fig, 15 tab, 41 ref. English summary.

Descriptors: *Water pollution sources, *Sulfates, *Nitrates, *The Netherlands, *Acid rain, Model studies.

Computations of import and export of pollutants SOx and NOx have been made for the Netherlands. Calculated concentrations in air and precipitation have been compared with measured concentrations. A sensitivity study on model input param-

eters has been conducted. Comparison of measured and calculated annual averaged concentrations shows that the model quite well predicts wet deposition in the Netherlands of acidifying components. An analysis is made of the trends in sulfate and nitrate concentrations in precipitation observed in the Netherlands during the years 1960-1980. A main conclusion of the investigation is that important transfrontier movements of acidifying components occur in the Netherlands. (Author's abstract)
W90-00184

CALCULATIONS OF DISPERSION PROCESSES IN GROUNDWATER BY THE METHOD OF FINITE ELEMENTS (BERECHNUNG VON AUSBREITUNGSVORGAENGEN IM GRUNDWASSER MIT DER METHODE DER FINITEN ELEMENTE).
Karlsruhe Univ. (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
H. M. Leismann.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80903/GAR. Price codes: E11 in paper copy, A01 in microfiche, Feb 1987. 144p, 82 fig, 1 tab, 30 ref.

Descriptors: *Path of pollutants, *Plumes, *Dispersion, *Groundwater pollution, *Groundwater movement, *Groundwater, Model studies, Water pollution sources.

Suitable numerical processes for the finite element method for calculating highly convective spread of harmful substances in groundwater are examined and compared. Reproduction of variations of solutions without simultaneous induction of numerical diffusion can only be achieved by using a scheme with a high order of consistency. Modelling spread processes in groundwater and the numerical calculation of highly convective spread processes was studied by the method of finite elements. Program technique and handling of a multilayer model for the horizontal calculation of spread processes in groundwater are explained (program technique, boundary conditions, discretisation, examples of calculations). These results differ considerably from those obtained using the conversion-dispersion equation. (Author's abstract)
W90-00187

TRAVELTIME AND DISPERSION IN THE POTOMAC RIVER, CUMBERLAND, MARYLAND, TO WASHINGTON, D.C.
K. R. Taylor, R. W. James, and B. M. Helinsky.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2257, 1985. 30p, 14 fig, 7 tab, 35 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Potomac River, *Maryland, *Dye releases, *Tracers, Traveltime, Mathematical studies.

A traveltime and dispersion study using rhodamine dye was conducted on the Potomac River between Cumberland, Maryland, and Washington, D.C. The flow during the study was at approximately the 90% flow duration level. The two sets of data were used to develop a generalized procedure for predicting traveltimes and downstream concentrations resulting from spillage of water soluble substances at any point along the river. A new procedure for calculating unit peak concentration depends on an analogy between a time-concentration curve and a scalene triangle. The unit peak concentration can be expressed in terms of the length of the dye or contaminant cloud. The new procedure facilitates the calculation of unit peak concentration for long reaches of river. The procedure was applied to a hypothetical situation in which 20,000 pounds of contaminant is spilled at a railroad crossing at Magnolia, West Virginia. The times required for the leading edge, the peak concentration, and the trailing edge of the contaminant cloud to reach Point of Rocks, Maryland (110 river miles downstream), are 295, 375, and 540 hours respectively, during a period when flow is at the 80% flow duration level. The peak conservative concentration would be approximately 340 micrograms per liter at Point of Rocks. (Lantz-PTT)
W90-00197

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W90-00201

RELATIONS BETWEEN QUALITY OF URBAN RUNOFF AND QUALITY OF LAKE ELLYN AT GLEN ELLYN, ILLINOIS.
For primary bibliographic entry see Field 4C.
W90-00212

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA.
For primary bibliographic entry see Field 2F.
W90-00218

TRITIUM MIGRATION FROM A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR CHICAGO, ILLINOIS.
Geological Survey, Urbana, IL. Water Resources Div.
J. R. Nicholas, and R. W. Healy.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2333, 1988. 46p, 25 fig, 5 tab, 31 ref.

Descriptors: *Illinois, *Tritium, *Path of pollutants, *Radioactive wastes, *Groundwater movement, Dolomite, Groundwater pollution, Chicago, Groundwater recharge, Geologic joints, Radioactive waste disposal.

The geologic and hydrologic factors that control migration of tritium from a closed, low-level radioactive waste disposal site were determined. The disposal site, which operated from 1943 to mid-1949, contains waste generated by research activities at the world's first nuclear reactors. Tritium has migrated horizontally at least 1,300 ft northward in glacial drift and more than 650 ft in the underlying dolomite. Thin, gently sloping sand layers in an otherwise clayey glacial drift are major conduits for groundwater flow and tritium migration in a perched zone beneath the disposal site. Tritium concentrations in the drift beneath the disposal site exceed 100,000 nanocuries per liter. Regional horizontal joints in the dolomite are enlarged by solution and are the major conduits for groundwater flow and tritium migration in the dolomite. A weathered zone at the top of the dolomite also is a pathway for tritium migration. The maximum measured tritium concentration in the dolomite is 29.4 nanocuries per liter. Fluctuations of tritium concentration in the dolomite are the result of dilution by a seasonal recharge from the drift. (Author's abstract)
W90-00226

EFFECT OF CONDITIONING TRANSPORT SIMULATIONS ON TRANSMISSIVITY, HEAD AND CONCENTRATION DATA.
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
D. Van Rooy, and D. Rosbjerg.
IN: Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice. International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. p 163-177, 9 fig, 24 ref.

Descriptors: *Model studies, *Path of pollutants, *Groundwater movement, *Simulation analysis, *Solute transport, *Hydraulic models, *Groundwater movement, *Groundwater pollution, Transmissivity, Stochastic process, Monte Carlo method, Kriging.

A stochastic solute transport model is applied to a case of groundwater contamination. The stochastic model is of the Monte Carlo type, uses a numerical flow and transport model, and views transmissivity as a random autocorrelated field. Transmissivity realizations are generated using the turning bands technique. Conditioning is done with regard to transmissivity, head and concentration observations. The conditioning procedures use simple and universal kriging, and utilize the kriging uncertainties to determine subsets of realizations that are in agreement with the observations at a predefined confidence level. Conditioning on head observations leaves large transport uncertainties. Conditioning on the transmissivity data has a more prominent effect. The single, most effective data type is the concentration data. Smallest transport uncertainties occur when all the data are simultaneously taken into account. (See also W90-00227) (Author's abstract)
W90-00229

REVIEW OF ACID RAIN MODELS FOR EUROPE.
Argonne National Lab., IL. Energy and Environmental Systems Div.
D. G. Streets.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011945. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8804153--1, April 14, 1988. 40p, 3 fig, 9 ref, append. DOE Contract W-31-109-Eng-38.

Descriptors: *Simulation analysis, *Acid rain, *Model studies, Policy making, RAINS, BICRAM, ACIDRAIN, Cost-benefit analysis, Computer models, Economic aspects, Water pollution effects, Water pollution control, Water pollution sources.

Three European acid rain models, RAINS, BICRAM, and ACIDRAIN, are reviewed in the context of the needs of a United Nations Economic Commission for Europe (UNECE) Task Force on Integrated Assessment Modeling, which desires to contribute to decisions on acid rain control strategies for Europe. The RAINS model is a PC-based simulation model that can evaluate the effects of acidic deposition on aquatic and terrestrial resources. Emissions and control technology information is sufficient to examine the effects of alternative control strategies. The RAINS model could be used now to investigate the cost-effectiveness of alternative control measures in Europe and to give a rough estimate of reduced damage to aquatic and terrestrial resources. The BICRAM model is a PC-based, noninteractive model that has similar emissions and cost capability to RAINS. It treats ecological damage through an empirical scheme of regional sensitivity measures and critical deposition loadings. BICRAM could be used alone to compare alternative control strategies, but is unable to make damage estimates. The somewhat more detailed emissions and control cost modules of BICRAM should be compared with those of RAINS. The ACIDRAIN model is a PC-based model designed as a decision aid for policy makers. Its strengths are its interactive, user-friendly software and its rigorous treatment of uncertainty using probability distributions. Before being used by the Task Force, it would need to be refined geographically and adapted to the European, rather than the U.K., context. Credible cost and damage functions need to be developed, either through expert judgement elicitation or derivation of regional dose-response functions from a model such as RAINS. (Lantz-PTT)
W90-00233

INSTALLATION RESTORATION PROGRAM. PHASE II-CONFIRMATION/QUANTIFICATION, STAGE 2. VOLUME I: LUKE AIR FORCE BASE, ARIZONA.
Weston (Roy F.), Inc., West Chester, PA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199 227. Price codes: A10 in paper copy, A01 in microfiche. Final Report for Period September 1986 to June 1988, June 1988. 220p, 65 fig, 42 tab. USAF Contract F33615-84-D-4400.

Descriptors: *Path of pollutants, *Arizona, *Military installation, *Fate of pollutants, *Pollutant identification, *Luke Air Force Base, Geophysics,

Pesticides, Groundwater quality, Organic compounds, Polychlorinated biphenyls, Heavy metals, Path of pollutants, Sediment contamination, Soil gases, Cleanup operations.

An Installation Restoration Program (IRP) Phase II State 2 study was performed at Luke AFB, AZ. Five sites (plus the base production wells) were investigated: a canal that receives runoff which has bypassed an oil/water separator; a petroleum, oil and lubricants disposal area (POL); a former fire training area; a site that contains both current and former fire training areas; and a series of lagoons that receive effluent from the base Sewage Treatment Plant. The scope of the investigation included soil-gas surveys at three sites, a geophysical survey at the POL Area, soil borings and subsurface soil sampling at all sites, monitor well installation and groundwater sampling at all sites including the base production wells, and surface water and sediment sampling at two sites. Analytes included volatile organic compounds, base/neutral-acid extractable compounds, pesticides, PCBs, heavy metals, and other indicator and site-specific parameters. Generally compounds that were detected above background in the various sampled media fall into one of three categories: (1) probable sampling artifacts; (2) scattered occurrences of compounds that are found infrequently, at low concentrations, and that do not appear in any identifiable pattern or distribution; and (3) occurrences of compounds that are found in an identifiable pattern or distribution. The majority of compounds detected at Luke AFB fall into one of the first two categories. Occurrences of compounds that fall into the third category include various target compounds in soil-gas at three sites, oil and grease in soil at the fire training area, nitrate/nitrite in groundwater at the Effluent Canal site, petroleum hydrocarbons in the sediment at the O/W Separator Canal, and lead in the soil and sediment at the Effluent Canal. None of these occurrences were considered to be significant in terms of threat to human health or to the environment. (Lantz-PTT)
W90-00234

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR BENZO(K)FLUORANTHENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W90-00236

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR PHENANTHRENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W90-00239

CHEMICAL DEGRADATION OF SUBSTITUTED AROMATIC HYDROCARBON COMPOUNDS IN SOIL/SEDIMENT SYSTEMS.
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
S. Shanmuganantha, and R. G. Luthy.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-007108. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/PC/90524--T2, January 1988. 110p, 45 fig, 15 tab, 29 ref, append. DOE Contract DE-FG22-86PC90524.

Descriptors: *Fate of pollutants, *Aromatic compounds, *Hydrocarbons, *Soil chemistry, *Chemical degradation, *Sediment contamination, Manganese oxide, Soil contamination, Chemical reactions, Organic compounds.

This study investigated the role of manganese oxide as an oxidant for substituted aromatic organic solutes. Manganese oxide may be the most reactive oxidizing agent in soils and sediments in the absence of molecular oxygen and nitrate. The study provides data on chemical mechanisms for abiotic degradation of anthropogenic organic solutes in soil/sediment and groundwater systems. The dissolution of MnOOH and gamma-MnO2 was studied with five nitrogen-containing aromatic compounds and seven alkyl-substituted aromatics under anoxic conditions. Quinoline, methylimidazole and 5,5-dimethyl hydantoin did not exhibit a significant dissolution rate at pH values around 6.0. Aniline dissolved gamma-MnO2 readily at a pH value of 4.4 but not at pH=6.5 in tests with comparatively high initial concentrations of organic and oxide. A methoxy substituent of aniline, p-anisidine, dissolved gamma-MnO2 very rapidly at low pH (4.4) with comparatively low concentrations of organic and oxide. Hydroquinone, catechol and their alkyl substituents dissolved appreciable amounts of gamma-MnO2 at pH 6.5, with initial organic concentrations in the range of 0.0005 M to 0.005 M and initial oxide concentrations around 0.002 M. In general, alkyl substitution increased the reaction rate except for trimethyl hydroquinone where resonance and/or steric hindrance was thought to be the reason for the deviation. Reactivity also increased with the size of the alkyl substituent (methyl- < butyl-). (Lantz-PTT)
W90-00246

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR NIAGARA BLUE 4B.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W90-00247

NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT IN INDONESIA: AN OVERVIEW.
Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 6A.
W90-00250

SEASONAL VARIATION IN UPTAKE AND RETENTION OF CADMIUM IN THE SEAWEED ZOSTERA MARINA L. FROM THE KIEL FJORD (WESTERN BALTIC SEA) (JAHRESGANG, AUFNAHME UND VERBLEIB VON CADMIUM IM SEEGRAS ZOSTERA MARINA L. AUS DER KIELER FORDE (WESTLICHE OSTSEE)).
Kiel Univ. (Germany, F.R.). Sonderforschungsbereich 95 - Wechselwirkung Meer - Meeresboden.
G. S. Dieckmann.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80223/GAR. Price codes: E09 in paper copy, A01 in microfiche. November 1982. 96p, 22 fig, 8 tab, 108 ref. English summary.

Descriptors: *Bioaccumulation, *Cadmium, *Heavy metals, *Algae, Seasonal variation, Leaves, Rhizomes, Shoots, Roots, Zostera, Molecular weight.

The bioaccumulation of cadmium by Zostera marina was investigated in field and laboratory experiments. A comparison was carried out between plants from two stations: one in the vicinity of a sewage outlet (Strande) and the other in the middle of the Kiel Fjord (Heikendorf). Seasonal variation of cadmium was investigated in leaves and rhizomes of different ages as well as in roots at monthly intervals in relation to biotic and abiotic factors in the water and sediment. Short term experiments in the laboratory were done to determine uptake and accumulation of cadmium in relation to salinity, temperature and light. The fate and subcellular localization were investigated using biochemical methods. The cadmium concentration in the leaves of Z. marina increases with the age of the leaves. The seasonal variation of cadmium in the shoots is different from that in the root/rhizomes. Salinity, temperature and light affect the uptake, accumulation and sequestering of cadmium. In the cytoplasm cadmium is bound to organic molecules of different molecular weights. A portion of the accumulated cadmium appears to be bound to a metallothionein like substance which has a molecular weight between 18000 and 20000 Dalton. No measurable quantities of cadmium were transported between underground and above ground plant parts. The cadmium accumulated in senescent leaves may pose a threat to detritivores in the coastal food chain. (Author's abstract)
W90-00260

FATE AND EFFECTS OF CRUDE OIL, DISPERSANTS, AND CHEMICALLY DISPERSED OIL IN A WADDEN SEA ECOSYSTEM: CHEMICAL ANALYSES (EINFLUSS UND AUSWIRKUNGEN VON ROHOEL, DISPERGATOREN UND CHEMISCH DISPERGIERTEM OEL AUF DAS OEKOSYSTEM WATTENMEER: CHEMISCHE ANALYSESN).
Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).
H. Farke, and N. Theobaid.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-82050/GAR. Price codes: E09 in paper copy, A01 in microfiche. Report no. DGMK-335, March 1987. 64p, 18 fig, 5 tab, 10 ref. English summary.

Descriptors: *Fate of pollutants, *Path of pollutants, *Water pollution effects, *Oil pollution, *Oil-water interfaces, *Oil, Sediments, Dispersion, Tides, Accumulation, Penetration.

Field experiments with mesocosms (Bremerhaven Caissons) show the fate and effects of chemically and mechanically dispersed crude oil and dispersants on a Wadden Sea ecosystem. Dispersed oil and the dispersant were added to the incoming tide. Depending on the experiment the oil concentrations in the water were between 2 ppm and 40 ppm. The experiments show no difference between chemically and mechanically dispersed oil in respect to oil accumulation at the sediment surface, and penetration and residence times of the oil in the sediment. Oil concentrations only increase at the sediment surface, penetration into deeper sediment layers is only poor. The residence time of the oil is short, 90 days after the end of the oil additions measurable oil concentrations in the sediment were only found in the experiment with 40 ppm oil. (Author's abstract)
W90-00261

MONITORING OF THE SEA: REPORT ON THE ACTIVITIES IN 1984 (UEBERWACHUNG DES MEERES: BERICHT FUER DAS JAHR 1984).
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-00263

MONITORING OF THE SEA: REPORT ON THE ACTIVITIES IN 1983 (UEBERWACHUNG DES MEERES: BERICHT FUER DAS JAHR 1983).
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-00264

DISTRIBUTION OF CHLORINATED HYDROCARBONS IN SEDIMENT AND SESTON OF THE RIVER ELBE (CHLORKOHLENWASSERSTOFF-VERTEILUNG IN SEDIMENTEN UND SCHWEBSTOFEN DER ELBE).
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
R. Strum, H. D. Knauth, K. H. Reinhart, and J. Gandrass.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80083/GAR. Price codes: E07 in paper copy, A01 in microfiche. Report no. GKSS--87/E/9, 1086. 18p, 13 fig, 3 tab, 14 ref. English summary.

Descriptors: *Path of pollutants, *West Germany, *River Elbe, *Chlorinated hydrocarbons, Seston, Sediments, Hexachlorobenzene, Octachlorostyrene, Gas chromatography, Variability, River Weser, North Sea, Baltic Sea.

During the period 1983-1985 sediment samples of the River Elbe (and for comparison from the River Weser, North Sea, Baltic Sea) were taken from the sediment surface and from levels up to one meter below. Seston was collected from depths one meter below the water surface by continuous-flow centrifugation. Samples were analyzed qualitatively and quantitatively for the concentrations of non-volatile chlorinated hydrocarbons. Sediment samples from different areas of the River Elbe show an Elbe-typical distribution pattern of chlorinated hydrocarbons compared to sediments from other waters of the Federal Republic of Germany, characterized by a dominating hexachlorobenzene peak and a marked octachlorostyrene peak in the capillary gas chromatogram. Concentrations of organochlorines in sediments from different parts of the River Elbe vary considerably. Correlations with the content of organic carbon can be made. Areas with a high sedimentation rate have twice as much chlorinated hydrocarbons in the first 4 to 5 cm of the sediment surface than in the layers below. In contrast to solutions with large amounts of hexachlorocyclohexanes, seston has a distribution pattern of organochlorines similar to sediment, although concentrations in general are much higher. (Author's abstract)
W90-00265

LABORATORY AND SEMI-TECHNICAL FIELD EXPERIMENTS FOR CHARACTERIZING THE MOST IMPORTANT PROCESSES INFLUENCING THE SORPTION AND MOBILIZATION OF HEAVY METALS IN SAND-FILTER-COLUMNS (LABOREXPERIMENTE UND HALBTECHNISCHE GELAENDEVERSUCHE ZUR CHARAKTERISIERUNG DER WICHTIGSTEN PROZESSE, WELCHE DIE BINDUNG UND MOBILISIERUNG VON SPUR ENMETALLEN IN LANGS AMSANDFILTERN BEEINFLUSSEN).
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
U. Foerstner, C. Sellhorn, W. Ahlf, and W. Calmano.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-82058/GAR. Price codes: E09 in paper copy, A01 in microfiche. Report UBA-FB-86-002, Contract UFOPLAN-Nr, March 1986. 76p, fig, tab, 51 ref.

Descriptors: *Path of pollutants, *Water chemistry, *Heavy metals, *Groundwater pollution, Solubility, Complexes, Iron oxyhydrates, Organic coatings.

Interactions of dissolved and solid metal species in groundwater are influenced by the conditions in solution (pH, redox, microbial activity, concentration of complexing substances, and temperature), by the type of reaction (sorption/desorption, precipitation/dissolution, flocculation, etc.), by the kinetics of these reactions and by the composition of solid phases. With respect to the latter components, surface-active phases such as amorphous iron oxyhydrates or organic coatings play a predominant role in these groundwater systems. (Author's abstract)
W90-00267

MODELLING OF LARGE-SCALE HEAT AND CONTAMINANT TRANSPORT IN GROUNDWATER: REPORT OF ACTIVITIES 1986/87 (MODELLERUNG DES GROSSRAEUMIGEN WAERMETRANSPORTS UND SCHADSTOFFTRANSPORTS IM GRUNDWASSER: TAETIGKEITSBERICHT 1986/87).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 2F.
W90-00269

HEAVY METAL CONCENTRATIONS IN THE MEDITERRANEAN ESTUARINE REGIONS OF THE RHONE, EBRO, PO, AND ARNO RIVERS (ERMITTLUNG DER AKTUELLEN SCHWERMETALLBELASTUNGEN IN DEN MITTELMEERASESTUARIEN VON RHONE, EBRO, PO UND ARNO).
Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet.
W. S. Dorten.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-81459/GAR. Price codes: E17 in paper copy, A01 in microfiche. August 1986. 274p, 121 fig, 26 tab, 122 ref. English summary.

Descriptors: *Estuaries, *Coastal waters, *Heavy metals, *Italy, Zinc, Cadmium, Lead, Copper, Nickel, Cobalt, Mercury, Solubility, Salinity, Precipitation, Monitoring.

Preservation of the coast line and estuary ecosystem requires efficient monitoring of toxic substances. The early detection of damages and adequate measures to avoid or eliminate them are based on investigations into the behavior of the pollutants concerned. This study analyzes the following metals found in samples of water and sediments of the Rhone, Ebro, Po and Arno estuaries: zinc, cadmium, lead, copper, nickel, cobalt, and mercury. The results obtained using analytical methods such as atomic absorption spectroscopy, X-ray fluorescene spectrometry and voltametry allow for statements as to the typical reaction paths metals can take in transport through estuaries. The study assesses the following essential transport mechanisms: (1) Soluble heavy metals subject to complex formation and exchanges; (2) combined particular metals largely influencing coastal sedimentation processes; and (3) with the salinity increasing in the estuary mixing zone particles characterized by their high adsorption affinity separate as flocculent precipitations which are extremely slow to deposit. (Author's abstract)
W90-00273

UPTAKE OF CADMIUM BY MARINE BACTERIA.
Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
For primary bibliographic entry see Field 5C.
W90-00289

NITRATE CONCENTRATIONS IN PERCOLATE AND GROUNDWATER UNDER CONVENTIONAL AND NO-TILL ZEA MAYS WATERSHEDS.
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W90-00292

HYDROLYSIS OF CHLOROSTILBENE OXIDE: I. HYDROLYSIS IN HOMOGENEOUS SYSTEMS.
Georgia Univ., Athens.
M. E. Metwally, and N. L. Wolfe.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 553-562, 1989. 5 fig, 5 tab, 19 ref.

Descriptors: *Epoxides, *Aquatic environment, *Fate of pollutants, *Hydrolysis, Chlorine, Kinetics, Sediments, Chlorostilbene oxide, Distilled water, Chemical properties, Chemical reactions.

The hydrolysis kinetics of 4-chlorostilbene oxide in buffered distilled water, in natural waters and in sediment-associated water are reported. The disappearance of 4-chlorostilbene oxide followed pseudo-first-order kinetics in buffered distilled water over the experimental pH range of 3 to 11. Below pH 5, acid-catalyzed hydrolysis dominates, with a second-order rate constant of 11.3 (+/-1.0)/M/min. Above pH 5, hydrolysis was independent of pH, with a rate constant of .000102(+/-0.000012)/min at 25 C. In natural waters, the hydrolysis rate constant of 4-chlorostilbene oxide had an average value of .00059(+/-0.000012)/min. In sediment-associated water, the observed rate constant was .00017(+/-0.000005)/min. Sorption of 4-chlorostilbene oxide to the humic materials in natural waters and biotic effects in sediment-associated water appropriately explained the differences from sterile buffer solutions. Buffer catalysis was observed, but on the other hand, a negative ionic strength effect was determined. The formation of diastereoisomers of 1-(4-chlorophenyl)-2-phenylethylene glycol as major products at both acidic and neutral pH values suggests that 4-chlorostilbene oxide undergoes acid-catalyzed as well as neutral hydrolysis reactions through an A-1 carbonium ion mechanism. The rate constant for hydrolysis of 4-chlorostilbene oxide at pH 14 is only 70 % faster than the hydrolysis rate constant over the pH range of 5 to 11, which suggests that nucleophilic addition of hydroxide ion is not the main hydrolytic mechanism of 4-chlorostilbene oxide hydrolysis at high pH values. (Author's abstract)
W90-00309

TOXICITY AND BIODEGRADATION OF PHTHALIC ACID ESTERS UNDER METHANOGENIC CONDITIONS.
New York Univ., NY. Inst. of Environmental Medicine.
O. A. O'Connor, M. D. Rivera, and L. Y. Young.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 569-576, 1989. 3 fig, 2 tab, 13 ref. Department of Energy Grant No. DE-AC02-84CE40657-AOO and NSF Grant No. CES-8605143.

Descriptors: *Phthalates, *Fate of pollutants, *Water pollution effects, *Hazardous wastes, *Priority pollutants, *Methane, *Biodegradation, *Anaerobic digestion, *Toxicity, Methanogenesis, Phthalates, Biochemistry, Biochemical methane potential, Anaerobic toxicity assay.

Phthalate, dimethyl phthalate, diethyl phthalate, dibutyl phthalate and di(2-ethylhexyl) phthalate were evaluated for their anaerobic biodegradability and toxicity to methanogenesis. Two anaerobic bioassays (the biochemical methane potential and the anaerobic toxicity assay) were used to monitor the stoichiometric conversion of added substrate to carbon dioxide and methane. Each phthalic acid ester was the only added carbon source (20 to 200 mg/l) prepared in prereduced defined medium using a 10 % (v/v) inoculum of municipal digester sludge. Over an extended incubation period (50 to 100 d), all concentrations of phthalate and dibutyl phthalate and low concentrations (20 mg/l) of dimethyl phthalate and diethyl phthalate achieved 75 to 100 % of their theoretical methane potentials. Higher concentrations (100 to 200 mg/l) of dimethyl phthalate and diethyl phthalate achieved 25 to 50 % of their theoretical methane potentials. Di(2-ethylhexyl) phthalate showed little mineralization at any concentration, although biotransformation of this substrate was indicated. Acclimation for most of the compounds took several days to weeks before degradation commenced. In the anaerobic toxicity assay, only concentrations greater than 20 mg/l diethyl phthalate produced any significant suppression of methanogenesis over time. All other substrates produced little inhibition of methanogenesis during the initial period of incubation. Generally, increased incubation led to increased levels of methane production above active control levels. (Author's abstract)
W90-00310

SURVIVAL, REPRODUCTION AND BIOCONCENTRATION IN INVERTEBRATES AND FISH EXPOSED TO HEXACHLOROBENZENE.
Corvallis Environmental Research Lab., OR.
A. V. Nebeker, W. L. Griffis, C. M. Wise, E. Hopkins, and J. A. Barbitta.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, Nol. 7, p 601-611, 1989. 7 fig, 5 tab, 19 ref.

Descriptors: *Invertebrates, *Path of pollutants, *Water pollution effects, *Toxicity, *Spawning, *Benzenes, *Fish, *Biological magnification, Population exposure, Amphipods, Annelids, Hexachlorobenzene, Survival, Waterfleas.

The cladoceran Daphnia magna, the amphipods Hyalella azteca and Gammarus lacustris, the annelid worm Lumbriculus variegatus and the fathead minnow Pimephales promelas were exposed to hexachlorobenzene in flow-through tests ranging from 2 to 68 days in duration to determine the effects of hexachlorobenzene on survival, tissue

bioconcentration and Hyalella and Lumbriculus growth and reproduction. No effects on survival, growth or reproduction were observed at concentrations of hexachlorobenzene up to saturation (5.0 microgram/l) or at tissue hexachlorobenzene concentrations of up to 223 microgram/g. Tissue hexachlorobenzene concentrations increased with increasing water concentrations, and tissue bioconcentration values were generally similar. Rapid uptake and change of tissue hexachlorobenzene concentration with change in water concentration occurred, with rapid depuration when the animals were no longer exposed to hexachlorobenzene in the water column, and tissue hexachlorobenzene concentrations were correlated closely with hexachlorobenzene water concentrations. (Author's abstract)
W90-00312

NITRATE MOVEMENT TO GROUNDWATER IN THE SOUTHEASTERN COASTAL PLAIN.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. K. Hubbard, and J. M. Sheridan.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 1, p 20-27, January-February 1989. 68 ref.

Descriptors: *Path of pollutants, *Nitrates, *Groundwater pollution, Southeastern United States, Surface-groundwater relations, Surface water, Fertilizers, Agricultural chemicals, Drinking water.

Nitrate contamination of surface water and groundwater is a concern for both health and environmental reasons. The current public health standard for drinking water requires nitrate concentration to be less than 10 parts per million. Levels higher than this have been recorded in a number of states, with high concentrations primarily associated with fertilizer use. Other factors contributing to nitrate contamination of groundwater include animal waste and agricultural management practices such as irrigation. Nitrate movement into groundwater is of concern in the southeastern United States for four primary reasons: (1) the area's sandy soils require relatively high nitrogen inputs for successful crop production; (2) this area has a high average annual rainfall and surface runoff which maximize potential root zone nitrate losses; (3) readily available groundwater has resulted in expanded irrigated acreage; and (4) preserving the quality of both surface water and groundwater in the Coastal Plain is important because the area is one of the few in the U.S. with abundant groundwater resources available for crop production. Nitrate movement in groundwater depends on geology, the potential routes for movement of surface water into groundwater, and those factors that control the rate and volume of water movement. Agricultural management, soils and land forms also affect the movement of nitrate in surface and groundwater. (Mertz-PTT)
W90-00329

AGNPS: A NONPOINT-SOURCE POLLUTION MODEL FOR EVALUATING AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Morris, MN.
R. A. Young, C. A. Onstad, D. D. Borsch, and W. P. Anderson.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 2, p 168-173. 7 fig, 3 tab, 15 ref.

Descriptors: *Runoff, *Runoff forecasting, *Rural areas, *Computer models, *Nonpoint pollution sources, *Agricultural watersheds, Soil erosion, Erosion, Storm water, Chemical oxygen demand, Sediment transport, Runoff rates, Runoff volume.

A computer model to analyze nonpoint-source pollution and to prioritize potential water quality problems in rural areas was developed. The event-based model used geographic cells of data units at resolutions of 0.4 to 16 hectares to represent upland and channel conditions. Within the framework of the cells, runoff characteristics and transport processes of sediment, nutrients, and chemical oxygen demand were simulated for each cell and routed to the outlet. This permitted the flow at any point in the watershed to be examined. Upland sources contributing to a potential problem could be identified and prioritized where remedial measures could be initiated to improve water quality most efficiently. The model has been preliminarily tested for runoff estimations with data from 20 different watersheds located in the north central United States. The model has also been used in several states to prioritize watersheds for the potential severity of water quality problems, to pinpoint critical areas within a watershed contributing to pollution, and to evaluate the effects of applying alternative managements practices. (Author's abstract)
W90-00337

RELATION BETWEEN ANTHROPOGENIC SO2 EMISSIONS AND CONCENTRATION OF SULFATE IN AIR AND PRECIPITATION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
C. Leck, and H. Rodhe.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 959-966, May 1989. 8 fig, 1 tab, 21 ref.

Descriptors: *Air pollution, *Path of pollutants, *Sulfates, *Acid rain, *Precipitation, Rainfall, Seasonal variation, Air circulation.

The relationship between anthropogenic SO2 emissions and the concentration of sulfate in air and precipitation has been investigated by comparing variations over the years, during the year and during the week. A 50% increase in sulfate concentration in Swedish precipitation between the late 1950s and the early 1970s, followed by a 20-25% decrease in concentration until the early 1980s agree well with estimated changes in anthropogenic SO2 emissions in the countries that contribute to the deposition in Sweden. A more detailed analysis of sulfate in Precipitation during the period 1972-1986 shows a decrease in concentration of about 40% and in deposition of about 20%. This decrease compares reasonably well with estimated based on model calculations of long-range transport and reported reductions in emissions in northern Europe. Variation of SO2 concentrations during the week exhibits a systematic pattern in approximate agreement with the expected variation in emission rates. A reasonable agreement also exists for sulfate concentration in air during the summer months in regions close to the major emission areas. It is concluded that there seems to be a qualitative agreement between changes in anthropogenic SO2 emissions and changes in the concentration and deposition of sulfate in northern Europe. (Author's abstract)
W90-00343

HYDROXYALKYLSULFONATE FORMATION: ITS ROLE AS A S(IV) RESERVOIR IN ATMOSPHERIC WATER DROPLETS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
T. M. Olson, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 985-997, May 1989. 6 fig, 3 tab, 23 ref. Calif. Air Resources Board Contract A4-075-32.

Descriptors: *Air pollution, *Atmospheric water, *Sulfates, *Acid rain, *Thermodynamics, *Water chemistry, *Kinetics, Hydrogen ion concentration, Chemical reactions, Fog, Clouds.

Kinetic and thermodynamic data obtained for the addition of S(IV) species with several aldehydes, including benzaldehyde, glyoxal, methylglyoxal, acetaldehyde, hydroxyacetaldehyde and glyoxylic acid, were used to predict their effectiveness as reservoirs for S(IV) in atmospheric water droplets. A linear free energy relationship between hydroxyalkylsulfonate stabilities and carbonyl hydration constants is presented which can be used to estimate the stability constants of other unknown carbonyl-bisulfite adducts. Formation rates of at least four of the adducts studied were greater than or comparable to the formation rate of alpha-hydroxymethanesulfonate (HMS). Under most fog and cloudwater conditions, it shown that these rates are slower than gas transfer processes. Equilibrium calculations in an open atmosphere indicate that hydroxyacetaldehyde, glyoxal, glyoxylic acid, and to a smaller extent, methylglyoxal, lead to potentially significant enrichment of S(IV) in the liquid phase, although HMS is an even better reservoir for S(IV). Scavenging of SO2 from the gas-phase due to hydroxyalkylsulfonate formation becomes important at high liquid water contents, ph > or = 5, and when an excess partial pressure of the aldehyde is present. The overall dissolution of RCHO and SO2 into a droplet and the subsequent formation of the hydroxyalkylsulfonate also results in a net increase in acidity, which in a weakly buffered solution can be more than a unit drop in pH. (Author's abstract)
W90-00344

EVALUATION OF THE EFFECT OF REDUCTIONS IN AMBIENT LEVELS OF PRIMARY POLLUTANTS ON SULFATE AND NITRATE WET DEPOSITION.
Iowa Univ., Iowa City. Dept. of Chemical and Materials Engineering.
S. Cho., Y. S. Chang, and G. R. Carmichael.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 1009-1031, May 1989. 15 fig, 6 tab, 22 ref.

Descriptors: *Path of pollutants, *Air pollution, *Acid rain, *Sulfates, *Nitrates, Model studies, Simulation, Hydrocarbons, Clouds, Atmospheric water.

The effect of reductions in the initial gas phase concentrations of SO2, NOx and reactive hydrocarbons on sulfate and nitrate production and deposition under precipitating conditions is studied using a one-dimensional time-dependent version of the STEM-II model. Simulations corresponding to highly polluted, moderately polluted and rural conditions are evaluated for both daytime and nocturnal conditions. The simulation results indicate that complex relationships can exist between the initial concentrations of primary pollutants and the resultant sulfate and nitrate deposition. The results also demonstrate a strong coupling between the gas phase photochemical cycles and acid formation in clouds within storm events. (Author's abstract)
W90-00346

EVALUATION OF PRECIPITATION CHEMISTRY SITING CRITERIA USING PAIRED STATIONS FROM NORTHERN MAIN AND SOUTHEASTERN TEXAS.
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
For primary bibliographic entry see Field 7A.
W90-00347

DEPOSITION OF THE MOST ACIDIFYING COMPONENTS IN THE NETHERLANDS DURING THE PERIOD 1980-1986.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Air Research.
J. Erisman, F. A. de Leeuw, and R. M. van Aalst.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 1051-1062, May 1989. 9 fig, 3 tab, 26 ref.

Descriptors: *Path of pollutants, *Acid rain, *The Netherlands, *Air pollution, *Spatial distribution, *Model studies, Sulfates, Nitrates, Precipitation, Atmospheric water.

Detailed maps of the deposition of acidifying components in The Netherlands are presented. The deposition was estimated from measurements of concentrations in the atmosphere and precipitation. Lack of information on the concentration of ammonia and ammonium in air made it impossible to estimate dry deposition. Therefore, these were estimated by model calculations. The nationwide averaged deposition of total (potential) acid in 1980 was ca. 5800 mol H(+)/ha-a. The most important acidifying components are sulfur oxides, nitrogen oxides and ammonia and their reaction products. Sulfur compounds (SOx) contributed about 49%, reduced nitrogen species (NHx) 23% and oxidized nitrogen species (NOy) 28% to the total deposition. Wet deposition contributes 30% to the total deposition. The spatial distribution of the total

deposition shows a gradient over The Netherlands with highest values in the south and lowest in the north. In 1986, the total deposition was estimated to be ca. 4900 mol H(+)/ha-a (40% SOx, 32% NOy and 28% NH.). The decrease is mainly the result of the lower SOx deposition. The relative contribution of inland emissions to the deposition in The Netherlands is about 41%. About 30% of the NHx deposition is due to foreign sources; for SOx this is about 80% and for NOy 65%. About 80% of Dutch emissions is deposited outside The Netherlands. The net export of SOx decreased between 1980 and 1985 from 150 kt/a to 35 kt/a, while the net export of NOy (ca. 280 kt/a) and NHx (ca. 155 kt/a) has remained constant over the period 1980-1986. (Author's abstract)
W90-00348

EFFECT OF IRRIGATION RATE ON SOLUTE TRANSPORT IN SOIL DURING STEADY WATER FLOW.
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 3F.
W90-00352

PREDICTION OF NITRATE LEACHING FROM A STRUCTURED CLAY SOIL USING TRANSFER FUNCTIONS DERIVED FROM EXTERNALLY APPLIED OR INDIGENOUS SOLUTE FLUXES.
Oxford Univ. (England). Soil Science Lab.
R. E. White.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 31-42, March 30 1989. 4 fig, 1 tab, 16 ref.

Descriptors: *Nitrates, *Leaching, *Clay loam, *Path of pollutants, *Soil physical properties, *Soil horizons, *Cores, *Probabilistic process, Core drilling, Sampling.

The feasibility of using the probability density function of travel times for surface-applied Cl(-) to model the leaching of indigenous soil NO3(-) was examined using a step-change in input of chloride solution to an assembly of thirteen large undisturbed cores taken from a grazed pasture. The chief problem lies in obtaining an accurate estimate of the initial NO3(-) concentration on a macroscale (i.e. between cores), but also evidence for differences in NO3(-) concentration on a microscale (between the interior and exterior of aggregates within each large core). Measurement of NO3(-) concentration made by extracting the whole soil volume overestimated the concentration in the transport volume, which was only a small fraction of the total water volume in the soil. When the NO3(-) concentration in the first effluent from each core was used as an estimate of the initial concentration in the soil transport volume, good agreement was obtained between the predicted and measured quantities of N leached, for individual cores, and when averaged over all cores. The best method of measuring independently the initial NO3(-) concentration in the transport volume of structured soils has yet to be determined. (Author's abstract)
W90-00353

PARTICLE TRAVEL TIMES OF CONTAMINANTS INCORPORATED INTO A PLANNING MODEL FOR GROUNDWATER PLUME CAPTURE.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
R. M. Greenwald, and S. M. Gorelick.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 73-98, March 30 1989. 12 fig, 5 tab, 27 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Plumes, *Cleanup operations, *Water pollution control, *Model studies, Aquifers, Remedies, Management planning, Injection wells.

In problems of groundwater contamination, the cost of long-term remediation can run into millions of dollars. Often the objective the cleanup strategy involves minimizing or constraining the time it take to remove all contaminants from the aquifer. A planning model for the withdrawal of contaminated groundwater is presented that enables one to consider remediation problems in which cleanup time is an important component. An existing quasi-analytic solution for advective contaminant transport is combined with nonlinear optimization to determine the distribution of pumping and injection rates. Although the simulation model is simple, its combined use with the optimization procedure is a useful tool. Examples demonstrate how cleanup time as a management variable can dictate the design of the restoration system. The relationship between pumping rates and the ultimate cleanup time proved to be a highly nonlinear function. Inspection of the 'cleanup time surface' for a reduced problem provides insight into the nature of this nonlinearity and how it influences the selected restoration design. Analysis indicated that increasing the total pumping rate can result in an increase in total cleanup time due to the deflection of contaminant travel paths. (Author's abstract)
W90-00356

BEHAVIOR OF DISSOLVED URANIUM IN GROUNDWATERS OF THE MORRO DO FERRO THORIUM DEPOSIT, BRAZIL.
Universidade Estadual Paulista, Sao Paulo (Brazil). Dept. de Fisica.
For primary bibliographic entry see Field 2F.
W90-00361

STOCHASTIC APPROACH OF THE HYDRODYNAMIC DISPERSION IN A FRACTURED MEDIUM: VARIABILITY OF THE DISPERSION COEFFICIENT (APPROCHE STOCHASTIQUE DE L'HYDRODISPERSION EN MILIEU FISSURE: VARIABILITE DU COEFFICIENT DE DISPERSION).
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
For primary bibliographic entry see Field 2F.
W90-00370

STUDY ON THE DEGRADATION OF N-ALKANES IN NO. 20 DIESEL OIL BY NATURAL STRAINS OF MICROORGANISMS FROM THE BOHAI SEA, (IN CHINESE).
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
S. Xiuqin, Y. Qiaoer, and L. Ying.
Hai Yang Yu Hu Chao (Oceanologia et Limnologia Sinica) HYHCAG, Vol. 19, No. 6, p 518-524, 1988. 7 fig, 3 tab, 6 ref. English summary.

Descriptors: *Fate of pollutants, *Path of pollutants, *Biodegradation, *Microbial degradation, *Organic compounds, *Oil, Alkanes, Microorganisms, Petroleum products, Gas chromatography.

An experiment was conducted using gas chromatography to study the n-alkanes in No. 20 diesel oil, which was degraded by the natural strains of microorganisms from the Bohai Sea. The experiment has proved that the gas chromatography is rapid and effective for checking the n-alkanes' change due to the petroleum biological degradation. The oil degradation of the n-alkanes by the natural strains of microorganisms was determined at 5, 50, 500 ppm diesel oil in 20 days of incubation, the biodegradation rates of the n-alkanes were 56.63%, 61.45% and 72.36%; the physical and chemical decomposition rates were 34.18%, 38.18%, and 19.85%; and the total degradation rates of the n-alkanes were 90.81%, 99.63%, and 92.21% respectively, at the three different diesel oil concentrations. It was clear under the experimental conditions that the n-alkanes (C 11-C22) in the No. 20 diesel oil could be mostly degraded. During the experiment, a better relation between the content of the n-alkanes and the numbers of the oil-degrading bacteria and fungi existed. (Author's abstract)
W90-00372

GEOCHEMICAL BEHAVIOR OF MERCURY IN SEDIMENTS OF CHANGJIANG RIVER ESTUARY AND HANGZHOU BAY, (IN CHINESE).
East China Sea Division for Environmental Protection Management, SOA, Shanghai, China.
C. Minyi, and Z. Xu.
Hai Yang Yu Hu Chao (Oceanologia et Limnologia Sinica) HYHCAG, Vol. 19, No. 6, p 601-605, 1988. 4 fig, 3 tab, 6 ref. English summary.

Descriptors: *Mercury, *Heavy metals, *Trace elements, *Sediments, *Sediment sampler, *Geochemistry, *China, *Path of pollutants, Sampling, Estuaries, Suspended load, Particulate matter.

Mercury content in the sediment samples taken from 25 stations of Changjiang River and Hangzhou Bay in July-August 1985 were determined by Cold-Vapor Atomic Fluorescence Spectrometry. The results indicate that the range of concentration of total mercury varied from 0.0104-0.0565 mg/kg, with an average of 0.0352 mg/kg. Compared with the mercury contents in the sediment of the same area determined before, no increases have been found. The correlation between the mercury contents and other environmental factors such as organic matter contents of sediments, suspended particle matter contents in sea water, grain size of sediment are discussed. Multivariate analysis techniques have are employed to identify the effects of three environmental factors controlling the distribution of mercury in sediments. The regression equation of the concentration of mercury in the Changjiang River and Hangzhou Bay sediments is presented. (Author's abstract)
W90-00373

MECHANISM OF NATIVE MANGANESE RELEASE IN SALT-TREATED SOILS.
North West Frontier Province Agricultural Univ., Peshawar (Pakistan). Dept. of Soil Science.
R. A. Khattak, W. M. Jarrell, and A. L. Page.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 701-705, May/June 1989. 2 fig, 4 tab, 22 ref.

Descriptors: *Irrigation effects, *Soil chemistry, *Path of pollutants, *Manganese, *Soil horizons, *Cation exchange, Ion exchange, Chemical reactions, Soil properties.

The release of native soil Mn was evaluated under laboratory conditions in Aiken (fine, kaolinitic, thermic Abruptic Durixeralfs) and Redding (fine, kaolinitic, thermic Abruptic Durixeralfs) clay loam soils saturated with either deionized water, or 75 and 150 mmol/L NaCl-CaCl2 solution. As the NaCl-CaCl2 concentrations increased, soil solution Mn increased and exchangeable Mn decreased proportionately. The regression of the net increases in soluble Mn vs. the corresponding decreases in exchangeable Mn produced the relationship, delta exchangeable Mn (mg/kg) = 0.788 + 0.868 delta soluble Mn (mg/kg), R squared = 0.63 ($P < 0.01$). This suggested that in these salt-treated soils, Mn was released into solution by a catio exchange reaction involving Ca and Na. The increases (122 to 252%) in exchangeable Mn after 5 D incubation, as compared to untreated air-dried soils, and the favorable pH (4.44 to 6.01) and Eh (redox potential) values (+ 202 to 254 mV) suggested that Mn(III,IV) was reduced to Mn(II). The Mn (II) primarily accumulated on the exchange phase and was subsequently displaced from the exchange sites by added Na(+) and Ca(2+). At equal equivalent concentrations, almost twice as much Mn entered the soil solution with Ca(2+) salts (Cl, ClO4, and NO3(-)) as with Na(+)-salts. The sum of soluble + exchangeable Mn did not increase (rather decreased significantly at the highest salt treatments). It was concluded that salinity had no effect on the extent to which Mn(III,IV) were reduced to Mn(II). These results indicated that management practices that increase soil solution salinity on soils high in native Mn could elevate soil solution Mn to concentrations potentially toxic to Mn-sensitive crops. (Author's abstract)
W90-00381

NITROGEN TRANSFORMATIONS IN SOILS PREVIOUSLY AMENDED WITH SEWAGE SLUDGE.
Harvard Univ., Cambridge, MA. Lab. of Microbial Ecology.
M. Boyle, and E. A. Paul.

Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 740-744, May/June 1989. 6 fig, 1 tab, 14 ref.

Descriptors: *Nitrogen, *Nitrification, *Soil chemistry, *Soil properties, *Sludge, *Denitrification, *Sludge disposal, Wastewater disposal, Microbial degradation.

A short-term (10 d) incubation experiment established the rates of nitrogen (N) transformations occurring in sludge-amended and nonamended soil. Utilizing a nitrification block (C2H2) with (15NH4)2SO4, first order rate constants were calculated for N immobilization, ammonification, nitrification, and denitrification. These rate constants were compared to values obtained after a long-term (87 wk) incubation performed on soils sampled from the same field plots. The short-term rates of ammonification were still higher than the controls 4 yr after the last sludge addition. Sludge applications over an 8-yr period (180 Mg/ha-yr) reduced soil nitrification potential compared to the controls when spiked with 15N. Denitrification did not cause a significant loss of N during either a short or long-term incubation period. The microbial biomass in the sludge-amended soil contained more N, which resulted in a microbial C/N ratio of approximately 4:1 vs. 5:1 for the controls. Initial (short-term) N immobilization rate constants were 0.43 for the sludge-amended and 0.35 for the non-amended soil. (Author's abstract)
W90-00382

NUTRIENT FLUX THROUGH A LOBLOLLY PINE FOREST FLOOR USING SIMULATED RAINFALL.
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
P. D. Duffy, J. D. Schreiber, and L. L. McDowell.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 3, p 951-957, May/June 1989. 2 fig, 6 tab, 28 ref.

Descriptors: *Forest soils, *Forest hydrology, *Cycling nutrients, *Acid rain effects, *Acid rain, Organic compounds, Phosphates, Nitrates, Rainfall-runoff relationships, Simulation, Pine trees.

Simulated rainfall was applied to 1 sq m forest floor plots in a 45-yr-old loblolly pine (Pinus taeda L.) plantation using a multiple-intensity simulator. On Day 1, 127.0 mm was applied and on Day 2, 76.2 mm. Runoff, collected at intervals throughout the applications, was analyzed for total organic C (TOC), PO4-P, NH4-N, and NO3-N. Deionized water (mean pH 5.3) and simulate acid rain (mean pH 4.2) were applied to two separate, replicate plots. The simulated acid rain reduced NH4-H concentrations in runoff from 0.08 to 0.04 mg/L but did not affect TOC or PO4-P. The TOC and PO4-P concentrations in runoff from all simulated rainfall applications were 18 and 0.011 mg/L, respectively. The NO3-N concentration was 0.02 mg/L for nonacid applications; the effects of acid applications on NO3-N were not determined because of analytical problems. Nutrient flux during nonacid rainfall applications for TOC, PO4-P, NH4-N, and NO3-N were, respectively, 5.2, 0.0003, 0.021, and 0.0006 mg/sq m-mm of applied rainfall. The pH was higher in runoff than in the applied acid rainfall but lower than in the applied nonacid rainfall. (Author's abstract)
W90-00388

PRODUCTION OF EXTRACELLULAR NUCLEIC ACIDS BY GENETICALLY ALTERED BACTERIA IN AQUATIC-ENVIRONMENT MICROCOSMS.
University of South Florida, St. Petersburg. Dept. of Marine Science.
J. H. Paul, and A. W. David.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 1865-1869, August 1989. 5 fig, 3 tab, 18 ref. EPA cooperative agreement CR813589-02-0 and NSF grant BSR 8601570.

Descriptors: *Bacterial physiology, *Escherichia coli, *Pseudomonas, *Genetic engineering, *DNA, *Aquatic environment, *Marine environment, Bahamas, Bradyrhizobium.

The factors which affect the production of extracellular DNA by genetically altered strains of Escherichia coli, Pseudomonas aeruginosa, Pseudomonas cepacia, and Bradyrhizobium japonicum in aquatic environments were investigated. Cellular nucleic acids were labeled in vivo by incubation with tritiated thymidine or tritiated adenine, and production of extracellular DNA in marine waters, artificial seawater, or mineral salts media was determined by detecting radiolabeled macromolecules in incubation filtrates. The presence or absence of the ambient microbial community had little effect on the production of extracellular DNA. Three of four organisms produced the greatest amounts of extracellular nucleic acids when incubated in low-salinity media (2 per mil artificial seawater) rather than high-salinity media (10-50 per mil artificial seawater). The greatest production of extracellular nucleic acids by P. cepacia occurred at pH 7 and 37 C, suggesting that extracellular DNA production may be a normal physiologic function of the cell. Incubation of labeled P. cepacia cells in water from Bimini Harbor, Bahamas, resulted in labeling of macromolecules of the ambient microbial population. Collectively these results indicate that (i) extracellular DNA production by genetically altered bacteria released into aquatic environments is more strongly influenced by physiochemical factors than biotic factors, (ii) extracellular DNA production rates are usually greater for organisms released in freshwater than marine environments, and (iii) ambient microbial populations can readily utilize materials released by these organisms. (Author's abstract)
W90-00390

COMPARISON OF VIBRIO PARAHAEMOLYTICUS GROWN IN ESTUARINE WATER AND RICH MEDIUM.
Maryland Univ., Cambridge. Horn Point Environmental Labs.
J. Pace, and T.-J. Chai.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 1877-1887, August 1989. 8 fig, 10 tab, 62 ref.

Descriptors: *Toxins, *Bacterial toxins, *Vibrio, *Bacterial physiology, *Microorganisms, *Estuarine environment, Lipids, Phospholipids, Proteins, Lipopolysaccharides, DNA, RNA, Enzymes, Bacteriophage, Kanagawa phenomenon.

Cell envelope composition and selected physiological traits of Vibrio parahaemolyticus were studied in regard to the Kanagawa phenomenon and growth conditions. Cell envelopes were prepared from cells cultured in Proteose Peptone-beef extract medium or filtered estuarine water. Protein, phospholipid, and lipopolysaccharide contents varied with culture conditions. The phospholipids present in the cell envelopes were identified as phosphatidylethanolamine, phosphatidylglycerol, and cardiolipin. Phosphatidylethanolamine decreased and phosphatidylglycerol increased in cells grown in estuarine water. Profiles of proteins separated by sodium dodecyl sulfate-polyacrylamide gel electrophoresis demonstrated numerous protein species, with 4 to 6 predominant proteins ranging from 26,000-120,000 in molecular weight. The profile of V. parahaemolyticus cell envelope proteins was unique and might be useful in the identification of the organism. Alkaline phosphatase activity was slightly higher in Kanagawa-negative strains and was higher in cells grown in estuarine water than in cells grown in rich laboratory medium. The DNA levels in estuarine water-grown cells increased, while RNA levels and cell volume decreased. Bacteriophage sensitivity typing demonstrated a close intraspecies relationship. Results indicated that Kanagawa-positive and -negative strains were closely related, but they could be grouped separately and may have undergone starvation-related physiological changes when cultured in estuarine water. (Author's abstract)
W90-00391

POLYCYCLIC AROMATIC HYDROCARBON DEGRADATION BY A MYCOBACTERIUM SP. IN MICROCOSMS CONTAINING SEDIMENT AND WATER FROM A PRISTINE ECOSYSTEM.
National Center for Toxicological Research, Jefferson, AR.
M. A. Heitkamp, and C. E. Cerniglia.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 1968-1973, August 1989. 4 fig, 1 tab, 21 ref.

Descriptors: *Water pollution treatment, *Polycyclic aromatic hydrocarbons, *Hydrocarbons, *Biodegradation, *Microbial degradation, *Aquatic bacteria, *Mycobacterium, *Fate of pollutants, Water pollution, Reservoirs, Sediments, Mineralization, Methylnaphthalene, Phenanthrene, Pyrene, Benzo(a)pyrene.

Microcosm studies were conducted to evaluate the survival and performance of a recently discovered polycyclic aromatic hydrocarbon (PAH)-degrading Mycobacterium sp. when this organism was added to sediment and water from a pristine ecosystem. Microcosms inoculated with the Mycobacterium sp. showed enhanced mineralization, singly and as components in a mixture, of 2-methylnaphthalene, phenanthrene, pyrene, and benzo(a)pyrene. Studies utilizing pyrene as the sole added PAH showed that the Mycobacterium sp. survived in microcosms for 6 weeks both with and without preexposure to PAH and mineralized multiple doses of pyrene. Pyrene mineralization rates for sterilized microcosms inoculated with the Mycobacterium sp. showed that competition with indigenous microorganisms did not adversely affect survival of or pyrene degradation by the Mycobacterium sp.. Pyrene mineralization of the Mycobacterium sp. was not enhanced by inorganic nutrient enrichment and was hindered by organic nutrient enrichment, which appeared to result from overgrowth of indigenous bacteria. This study demonstrates the versatility of the PAH-degrading Mycobacterium sp. and expands its potential applications to include the degradation of 2-, 3-, 4-, and 5-ringed PAHs in sediments. (Author's abstract)
W90-00393

BACTERIAL COMMUNITY STRUCTURE AND FUNCTION ALONG A HEAVY METAL GRADIENT.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W90-00394

ECOLOGY OF VIBRIO MIMICUS IN AQUATIC ENVIRONMENTS.
Okayama Univ. (Japan). Dept. of Environmental Hygiene.
M. A. R. Chowdhury, H. Yamanaka, S. Miyoshi, K. M. S. Aziz, and S. Shinoda.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 2073-2078, August 1989. 5 fig, 3 tab, 21 ref. International Center for Diarrheal Disease Research, Bangladesh Grant 016700.

Descriptors: *Bangladesh, *Japan, *Bacterial analysis, *Vibrio, *Pathogenic bacteria, *Aquatic environment, Water temperature, Salinity, Seasonal variation, Antibiotics.

An environmental study was done to examine the prevalence of Vibrio mimicus in some aquatic environments of Dhaka, Bangladesh, and of Okayama, Japan. Water samples from Dhaka environments and water and plankton samples from Okayama environments were quantitatively as well as qualitatively analyzed throughout the seasons for V. mimicus. The organism was isolated from Bangladesh environments throughout the year, whereas it was not isolated in Okayama when the water temperature fell below 10 C. Samples with as many as 900 CFU of V. mimicus per 100 ml of water in Dhaka and 15,000 CFU of V. mimicus per 100 ml of water in Okayama were detected during the study period. V. mimicus was not found in any environment with an average salinity of 10 per mil or more. Brackish environments with an average salinity of 4% were observed to be the optimal natural condition for the pathogen. Using the API 20E system with the conventional test methods, variations in biochemical properties within the V.

mimicus species were observed. This study reveals the inefficacy of the API 20E system to identify a significant percentage of V. mimicus. Therefore, in addition to the API 20E system, a salt tolerance test and a string test are recommended for identification of this species. Susceptibility testing of strains isolated from Okayama environments showed higher resistance to ampicillin and susceptibility to trimethoprim-sulfamethoxazole when compared with environmental isolates of V. mimicus from Bangladesh. (Author's abstract)
W90-00396

MINERALIZATION OF SURFACTANTS BY MICROBIOTA OF AQUATIC PLANTS.
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
T. W. Federle, and B. S. Schwab.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 2092-2094, August 1989. 3 fig, 12 ref.

Descriptors: *Surfactants, *Nonionic surfactants, *Linear alkyl sulfonates, *Municipal wastewater, *Aquatic plants, *Mineralization, *Biodegradation, *Microbial degradation, *Fate of pollutants, Rhizosphere, Ponds, Cattails, Duckweed.

The biodegradation of linear alkylbenene sulfonate (LAS) and linear alcohol ethoxylate (LAE) by the microbiota associated with duckweed (Lemma minor) and the roots of cattail (Typha latifolia) was investigated. Plants were obtained from a pristine pond and a pond receiving wastewater from a rural laundromat. Cattail roots and duckweed plants were incubated in vessels containing sterile water amended with (C14)LAS, (C14)LAE, or C14-labeled mixed amino acids (MAA). Evolution of C14-CO2 was determined over time. The microbiota of cattail roots from both ponds mineralized LAS, LAE, and MAA without lag periods, and the rates and extents of mineralization were not significantly affected by the source of the plants. Mineralization of LAS and LAE was more rapid in the rhizosphere than in nearby root-free sediments, which exhibited differences as a function of pond. The microbiota of duckweed readily mineralized LAE and MAA but not LAS. The rate and extent of mineralization were not affected by the source of the duckweed. (Author's abstract)
W90-00398

EXPERIMENTAL EVALUATION OF POLLUTION POTENTIAL OF ANIONIC SURFACTANTS IN THE MARINE ENVIRONMENT.
Cadiz Univ. (Spain). Faculty of Sciences.
J. M. Quiroga, D. Sales, and A. Gomez-Parra.
Water Research WATRAG, Vol. 23, No. 7, p 801-807, July 1989. 4 fig, 4 tab, 29 ref.

Descriptors: *Municipal wastewater, *Water pollution sources, *Spain, *Surfactants, *Detergents, *Linear alkyl sulfonates, *Biodegradation, *Microbial degradation, *Marine environment, *Fate of pollutants, Water temperature, Salinity, Seasonal variation, Sodium dodecylbenzene sulfonate, Bay of Cadiz, Spain, Marine sediments.

The influence of temperature and salinity on the biodegradation of a commercial anionic surfactant (sodium dodecylbenzene sulfonate, LAS) in waters and sediments of the Bay of Cadiz (SW Spain) was investigated. The assays were carried out using batch reactors, and the surfactant concentrations used were similar to those found in the urban effluents which discharge into the bay. Temperature was found to have a decisive effect on the degradation rate. At temperatures of 20-25 C, degradation exceeded 90% within less than 10 days of assay whereas at temperatures under 10 C, degradation scarcely took place (the percentage of degradation did not exceed 5% after 21 days of assay). Variation in salinity, particularly marked during wet seasons, disturbs the activity of bacterial flora and slows down biodegradation of surfactant. All this means that the pollution potential of urban waste containing detergents undergoes significant seasonal variation. The rate of surfactant degradation was remarkably accelerated in the presence of sediments, except those tests where anoxic conditions were established. This occurs where there is high benthic oxygen demand from sediments containing high percentage of easily biodegradable organic matter. (Author's abstract)
W90-00411

RELATIVE CONTRIBUTIONS OF FOOD AND WATER IN THE ACCUMULATION OF CO-60 BY A FRESHWATER FISH.
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France). Lab. de Radioecologie des Eaux Continentales.
J. P. Baudin, and A. F. Fritsch.
Water Research WATRAG, Vol. 23, No. 7, p 817-823, July 1989. 3 fig, 6 tab, 38 ref.

Descriptors: *Cobalt radioisotopes, *Water pollution, *Bioaccumulation, *Radioactive wastes, *Path of pollutants, *Carp, Food contamination, Trace elements.

In order to assure an accurate evaluation of the relative importance of food and water as Co-60 sources to the carp, an experiment was carried out simultaneously on 3 homogeneous groups of 10 juvenile fish. The individuals of the first group were maintained in separate aquaria and offered 45 daily rations of labelled food over a 63-day period. Each carp of the two other groups was placed in one of the 20 twenty compartments of a 210 l tank and exposed to 68,000 Bq Co-60/l. One group was fed with radioactive food, the other with non-radioactive food. The contamination kinetics showed that the steady state should be reached after 165 days for fish exposed to Co-60 in both sources. According to the Co-60 concentration in the fish of the 3 treatment groups the accumulation from water accounted for 75% of the total radioactivity and the accumulation of the radionuclide from both water and food was additive. Depuration of Co-60 from carp was a relatively intensive process reflecting a high Co turnover. Biological half-lives for loss from the long-lived compartment ranged from 53 days in fish previously contaminated from food to 87 days in fish previously contaminated from water. At the end of the depuration phase the fish were dissected to determine the Co-60 distribution in their tissues. There was no significant difference between the fish of the 3 treatment groups; the greatest fraction of residual radiocobalt resided in digestive tract that accounted for 20-25% of the total Co-60 body burden. (Author's abstract)
W90-00413

EPILITHON AND DISSOLVED OXYGEN DEPLETION IN THE MANAWATU RIVER, NEW ZEALAND: SIMPLE MODELS AND MANAGEMENT IMPLICATIONS.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
J. M. Quinn, and P. N. McFarlane.
Water Research WATRAG, Vol. 23, No. 7, p 825-832, July 1989. 5 fig, 4 tab, 26 ref, append.

Descriptors: *Industrial wastewater, *Municipal wastewater, *Rivers, *Biochemical oxygen demand, *New Zealand, *Dissolved oxygen, *Respiration, *Algae, *Fungi, Epilithon, Water temperature, Biomass, Biological oxygen demand, Computer models, Manawatu River.

The relationship between epilithic biomass and oxygen depletion was studied above and below wastewater discharges to the Manawatu River in an attempt to guide river management by defining the maximum respiration rates and the corresponding epilithic biomass consistent with maintenance of the legal minimum dissolved oxygen (DO) concentration of 5 g/cu m. A computer model, which simulated the river DO under lowflow conditions, predicted that the maximum allowable respiration rate giving a dawn DO concentration of 5 g/cu m ranged from 20 g oxygen/sq m/d at 21 C to 24.5 g oxygen/sq m/d at 12 C. A multiple regression model developed from chamber measurements made in situ showed that the total biomass density and water temperature accounted for 73 % of the variation in the respiration rate observed. When adapted to allow for respiration occurring in the water column, the model gave reasonably accurate predictions of respiration when checked against the whole river respiration rate measurements. Biomass densities, at which DO levels reach 5 g/cu m predicted using these models, ranged from 34 g ash free dry wt/sq m at 21 C to 143 g ash free dry wt/sq m at 12 C. Analyses of historical hydrological data and the results of epilithon growth measurements under a variety of water quality conditions in the Manawatu River indicate that the present management strategy of limiting instream BOD5 to below 5 g/cu m but not limiting nutrient (N and P) levels will not prevent the occurrence in summer of the predicted nuisance biomasses and hence unacceptable deoxygenation. (Author's abstract)
W90-00414

SOLUBILITY AND RELEASE OF FLUORINE AND MOLYBDENUM FROM OIL SHALE SOLID WASTES.
Wyoming Water Research Center, Laramie.
K. J. Reddy, and V. R. Hasfurther.
Water Research WATRAG, Vol. 23, No. 7, p 833-836, July 1989. 2 fig, 5 tab, 15 ref. U.S. Department of Energy cooperative agreement DE-FC21-86MC10076.

Descriptors: *Oil shale, *Solid waste disposal, *Water pollution sources, *Molybdenum, *Fluorine, *Path of pollutants, Solubility, Hydrogen ion concentration.

Surface disposal of oil shale solid wastes may contaminate surface water and groundwater resources with toxic levels of F and Mo. Three different oil shale solid wastes produced from processing raw oil shale, at different temperatures, were subjected to equilibrium solubility studies to examine the solid phases responsible for the release of F and Mo from oil shale solid wastes into the infiltrating water. The results suggested that increased retorting temperatures increased pH from 10.75 to 12.35, decreased dissolved F concentrations from 48.8 to 3.5 mg/l, and increased dissolved Mo concentrations from 1.9 to 3.9 mg/l in oil shale solid waste equilibrium waters. Chemical speciation of total soluble F and Mo concentrations in oil shale solid waste equilibrium waters indicated that F was present mainly as F(-), NaF(0), and CaF(+). Mo was present was MoO4(--) and HMoO4(-). Further results of this study suggested that dissolved F and Mo concentrations in oil shale solid waste equilibrium waters appear to be controlled by CaF2 (fluorite) and CaMoO4 (powellite), respectively. (Author's abstract)
W90-00415

PHOTODEGRADATION OF FERRIC ETHYLENEDIAMINETETRA(METHYLENEPHOSPHONIC ACID) (EDTMP) IN AQUEOUS SOLUTION.
Procter and Gamble/ETC, Strombeek, Bever (Belgium).
E. Matthijs, N. T. De Oude, M. Bolte, and J. Lemaire.
Water Research WATRAG, Vol. 23, No. 7, p 845-851, July 1989. 7 fig, 1 tab, 18 ref.

Descriptors: *Detergents, *Chelating agents, *Photolysis, *Fate of pollutants, *Ethylenediaminetetra(methylenephosphonic acid), Phosphate, Half-life.

The photodegradation of ferric ethylenediaminetetra(methylenephosphonic acid) was studied. Irradiation of a 0.0001 M aqueous solution was performed with monochromatic light at 254 and 365 nm. Initial quantum yields were calculated vs chemical actinometry. The degradation process was monitored by the analytical determination of the orthophosphate formed. Examination of the rate and extent of the photolysis indicated a rapid degradation up to 75% of the organic phosphonates into orthophosphate. A non-chelating, photostable product was formed and identified by gas chromatography-mass spectrometry as N-methylaminomethylenephosphonic acid. The half-life in natural waters, calculated for the top layer of the water body and for the average climatical conditions on central Europe, averaged 26 h. The significance of these findings in natural water systems depends on the extent of formation of photo-

sensitive EDTMP complexes and on the competition and exchange between other metals ions. (Author's abstract)
W90-00417

AUTECOLOGY OF VIBRIO VULNIFICUS AND VIBRIO PARAHAEMOLYTICUS IN TROPICAL WATERS.
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
S. Rivera, T. Lugo, and T. C. Hazen.
Water Research WATRAG, Vol. 23, No. 7, p 923-931, July 1989. 2 fig, 4 tab, 37 ref. Sea Grant R/LR-08-87-THA1, NIH Public Health Service grants RR-2657 and RR-8102, U.S. Department of Energy Contract No. DE-AC09-76SR00001.

Descriptors: *Pathogenic bacteria, *Vibrio, *Coastal waters, *Shellfish, *Water pollution, *Water quality, Beaches, Mangrove swamps, Estuaries, Salinity, Population density, Puerto Rico.

Water and shellfish samples collected from estuaries, mangroves and beaches along the coast of Puerto Rico were examined for Vibrio vulnificus and V. parahaemolyticus. An array of water quality parameters were also measured simultaneous with bacteria sampling. Both species were associated with estuary and mangrove locations, and neither was isolated from sandy beaches. Densities of V. vulnificus were negatively correlated with high salinities, 10-15 ppt being optimal. V. parahaemolyticus was isolated from sites with salinities between 20-35 ppt, the highest densities occurring at 20 ppt. Densities of Vibrio spp. and V. parahaemolyticus for a tropical estuary surpassed those reported for temperate estuaries by several orders of magnitude. Both densities of total Vibrio spp. and V. parahaemolyticus in the water were directly related to densities of fecal coliforms, unlike V. vulnificus. The incidence of ONPG(+) strains among sucrose(-) Vibrio spp. served as an indicator of the frequency of V. vulnificus in this group. More than 63% of the V. vulnificus isolated were pathogenic. V. vulnificus and V. parahaemolyticus occupy clearly separate niches within the tropical estuarine-marine ecosystem. (Author's abstract)
W90-00427

UPTAKE OF NICKEL AND CADMIUM BY VEGETABLES GROWN ON SOIL AMENDED WITH DIFFERENT SEWAGE SLUDGES.
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5E.
W90-00430

NITROGEN AND PHOSPHOROUS YIELDS IN RUN-OFF FROM SILTY SOILS IN THE MISSISSIPPI DELTA, U.S.A.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. L. McDowell, G. H. WIllis, and C. E. Murphree.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 2-3, p 119-137, March 1989. 12 fig, 9 tab, 25 ref.

Descriptors: *Water pollution sources, *Nutrients, *Run-off, *Surface runoff, *Nitrogen, *Phosphorous, *Enrichment, Cotton, Silty soils.

Nutrients and sediment concentration in surface run-off from an 18.7-ha watershed, planted to continuous cotton (Gossypium hirsutum L.), were measured from March 1973 through February 1979 to determine: (1) nutrient and sediment yields, (2) mode of nutrient transport, (3) nutrient concentration frequency distributions, and (4) nitrogen (N) and phosphorous (P) enrichment in sediments. The watershed, consisting of silt loam (72% and silty clay (28%) soils, had been landformed to a mean slope of 0.2%. The 6-year average annual rainfall, run-off and sediment yields were 1335 mm, 543 mm and 20.8 t/ha, respectively. Nitrogen fertilizer was applied at the rate of 171 kg/ha/year. P fertilizer was not applied because cotton growing on these soils does not respond to P fertilization. The 6-year average soluble N (ammonium N plus nitrate N) and P yields were 7.7 and 1.6 kg/ha/year, respectively, compared with sediment N and P yields of 34.6 and 19.6 kg/ha/yr. About 18 and 7% of the total (sum of solution and sediment) N and P yields were transported in solution; the remainder was transported by the sediments. Sediment and nutrient yields were greater than expected from these flatlands. Without P fertilizer additions, soluble P concentrations in 77% of the run-off exceeded the 0.1 mg/l criterion proposed by the U.S. Environmental Protection Agency. Improved run-off and erosion control practices are needed to significantly reduce sediment and chemical yields. (Author's abstract)
W90-00431

BIOCONCENTRATION AND METABOLISM OF ALDRIN AND PHORATE BY THE BLUE-GREEN ALGAE ANABAENA (ARM 310) AND AULOSIRA FERTILISSIMA (ARM 68).
Sri Venkateswara Coll., New Delhi (India). Dept. of Zoology.
P. S. Dhanaraj, S. Kumar, and R. Lal.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 2-3, p 187-193, March 1989. 3 tab, 16 ref.

Descriptors: *Path of pollutants, *Biological magnification, *Metabolism, *Bioaccumulation, *Insecticides, *Aldrin, *Algae, *Cyanophyta, Bioconcentration, Phorate.

Bioconcentration and metabolism of two insecticides, viz. aldrin and phorate, in two blue-green algae, Anabaena sp. and Aulosira fertilissima are studied. Anabaena sp. and Aulosira fertilissima showed marked ability to bioconcentrate aldrin and phorate from culture medium. Uptake was directly related to the insecticide concentration in the medium and was inversely related to the water solubility of the insecticides. Bioconcentration of aldrin in Anabaena sp. and A. fertilissima ranged from 3.9 to 247.5 microg/g, respectively. Maximum concentration of aldrin in the blue-green algae was reached after 8-16 h and that of phorate after 16-32 h. Aldrin was metabolized to dieldrin by both blue-green algae but no metabolism was noticed in the case of phorate. (Author's abstract)
W90-00433

APPLICATION OF THE QWASI (QUANTITATIVE WATER AIR SEDIMENT INTERACTION) FUGACITY MODEL TO THE DYNAMICS OF ORGANIC AND INROGANIC CHEMICALS IN LAKES.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay, and M. Diamond.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1343-1365, 1989. 2 fig, 9 tab, 24 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Polychlorinated biphenyls, *Fate of pollutants, *Lakes, *Model studies, *Sedimentation, *Organic compounds, *Inorganic compounds, Quantitative water air sediment interaction, Fugacity.

A brief description is presented of the QWASI fugacity model which describes the fate of a chemical in a lake system consisting of water, bottom and suspended sediments, and air. Descriptions of the processes included in the model are advective flow, volatilization, sediment deposition, resuspension and burial, sediment-water diffusion, wet and dry atmospheric deposition and degrading reactions. The steady state solution of the model is illustrated by application to PCBs in Lake Ontario using the equilibrium criterion of fugacity as the variable controlling environmental fate of the chemical. Use of fugacity as an equilibrium criterion is not suitable for involatile chemicals, such as metals, or ionic species, because fugacities are calculated from a basis of vapor phase concentrations. For metals and ions with zero or negligible vapor pressure, the use of the equilibrium criterion of activity is more appropriate since activities are calculated from a water phase base. It is, however, suggested that a new equilibrium criterion, termed the 'aquivalent' concentration, is preferable. It has the advantage that, with minor modifications, the formalism developed in the QWASI approach can be applied with its attendant benefits of mathematical simplicity and the ability to readily compare the relative rates of diverse environmental fate processes. Steady and unsteady state equations can be assembled and solved. This criterion is illustrated by applying it on a steady state basis to the PCB example and to the fate of lead in Lake Ontario. The implication of the results is that the movement of PCBs, and particularly lead, is very sensitive to suspended particle and sediment dynamics in Lake Ontario. Sediment deposition will increase the amount and concnetration of both chemicals (especially lead) in the lake sediments. The PCB and lead data should be considered to be illustrative rather than definitive assessments of concentrations and fluxes in Lake Ontario. In total, the model provides a systematic rigorous method of considering the environmental dynamics of chemicals. (Miller-PTT)
W90-00435

ENVIRONMENTAL BEHAVIOR OF POLYCHLORINATED MONO-METHYL-SUBSTITUTED DIPHENYL-METHANES (ME-PCDMS) IN COMPARISON WITH POLYCHLORINATED BIPHENYLS (PCBS): PART II. ENVIRONMENTAL RESIDUES AND AQUATIC TOXICITY.
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
H. Friege, W. Stock, J. Alberti, A. Poppe, and I. Juhnke.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1367-1378, 1989. 3 fig, 4 tab, 14 ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, *Toxicity, *Aquatic environment, *Bioaccumulation, Freshwater, Comparison studies.

The substitution of polychlorinated biphenyls (PCBs) by monomethyl-substituted Diphenylmethane (Me-TCDMs) is investigated with particular emphasis on the aquatic toxicity and bioaccumulation properties in freshwater systems. In many industrialized countries, production and use of PCBs have been restricted by national or international regulation. A large number of PCB substitution products is available, including Me-TCDMs. This class of compounds is offered for several applications, especially for hydraulic mining equipment and transformers. Me-TCDMs have been detected in surface water due to mining effluents. In aquatic systems, Me-TCDMs accumulate in fish and sediment to a similar extent as PCBs. The aquatic toxicity of Me-TCDMs (Ugilec 141) matches that of Clophen A 30 with the exception of toxicity towards algae. Taking into account pyrolysis experiments, ecotoxicological data, and bioaccumulative properties, it is concluded that Me-PCDMs are not suitable substitutes for PCBs. (Miller-PTT)
W90-00436

ENVIRONMENTAL IMPACT OF THE USE OF IVERMECTIN: ENVIRONMENTAL EFFECTS AND FATE.
Merck Sharp and Dohme Research Labs., Rahway, NJ.
For primary bibliographic entry see Field 5C.
W90-00439

METABOLISM OF OCTACHLOROSTYRENE IN THE BLUE MUSSEL (MYTILUS EDULIS).
Alfred-Wegener-Inst. fuer Polarforschung, Bremerhaven (Germany, F.R.).
I. Bauer, K. Weber, and W. Ernst.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1573-1579, 1989. 2 fig, 15 ref.

Descriptors: *Chlorinated hydrocarbons, *Fate of pollutants, *Path of pollutants, *Biotransformation, *Octachlorostyrene, *Aromatic compounds, *Mollusks, *Mussels, Blue mussels, Gas chromatography, Metabolism.

The fact that blue mussels (Mytilus edulis) exhibit higher metabolic capabilities for the biotransformation of octachlorostyrene (OCS) is questioned. Mussels were exposed to OCS for 240 hours in a

closed aquarium system. Perchloroaromatic compounds, such as hexachlorobenzene and pentachloronitrobenzene, are known to be metabolized by various organisms via the mercapturic acid pathway, resulting in the formation of methylthioethers. Octachlorostyrene was degraded similarly to two isomeric methylthioheptachlorostyrenes as identified by gas chromatography-mass spectrometry. Formation of heptachlorostyrene was not identified. Comparison of the mass spectroscopic data of the compound tentatively postulated by another author to be heptachlorophenylacetic acid and the spectra obtained from the methylthioheptachlorostyrenes found in this experiment indicates that the compounds are probably identical. (Miller-PTT)
W90-00440

EFFECT OF THE MICROBIAL POPULATION SIZE ON THE DEGRADATION OF LINEAR ALKYLBENZENE SULFONATE IN LAKE WATER.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
A. Yediler, Y. Zhang, J. P. Cai, and F. Korte.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1589-1597, 1989. 4 fig, 3 tab, 18 ref.

Descriptors: *Fate of pollutants, *Lakes, *Alkylbenzene sulfonates, *Detergents, *Biodegradation, *Microbial degradation, Correlation analysis, Population density.

The correlation was studied between the degradation rate of linear alkylbenxene sulfonate (LAS), a commercially marketed detergent, and the initial bacterial population size in lake water, (Dong Hu, Wuhan, P.R. China). The experiment required the addition of 1.5 mg/l LAS to lake water samples collected from various locations of Dong Hu with different concentrations of LAS and different microbial levels. The exposure time was 72 hours and samples were taken at time zero, then at 12, 24, 36, 48 and 72 hr. Each sample was submitted to the methylene blue active substances analytical procedure for the determination of remaining anionic substances. Microbial density was estimated by dilution plate method for each test medium at time zero and 72 hr. The results indicate that the LAS degradation rate was affected by the size of microbial population at the test medium. The LAS concentrations of Dong Hu water varied from 15 to 82 microg/l during autumn. A good correlation between the LAS degradation rates and total bacterial population size was observed in all LAS experiments. The extent of LAS degradation by bacteria in location 1 were much higher than in test medium from location 2, location 3 and the control. The slowest biodegradation was observed in location 3, with approximately 22% degradation in the first 12 hr, a latency period of between 12 and 36 hr, and then a slow increase to 35% after 48 to 72 hr, respectively. (Miller-PTT)
W90-00441

STUDY OF METAL POLLUTION (CD, CU, PB, ZN) ALONG THE ATLANTIC COAST OF MOROCCO BETWEEN KENITRA AND TEMARA (ETUDE DE LA POLLUTION METTALLIQUE (CD, CU, PB, ZN) DU LITTORAL ATLANTIQUE MAROCAIN ENTRE KENITRA ET TEMARA).
Mohammed V Univ., Rabat (Morocco). Lab. de Microbiologie.
M. Mahyaouhi, M. Saghi, and I. Kharchaf.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1639-1655, 1989. 4 fig, 5 tab, 17 ref. English summary.

Descriptors: *Water pollution sources, *Path of pollutants, *Morocco, *Marine environment, *Cadmium, *Copper, *Lead, *Zinc, Heavy metals, Toxicity, Coastal areas.

Among the natural biotopes, the marine environment is the most sensitive to pollution. Atmospheric contributions, voluntary or accidental discharges, and industrial and urban discharge into rivers use the ocean as a natural repository, and transform the coasts (in particular) to a vulnerable zone. The throwing out of materials that are rich in toxic metals is dangerous for marine resources and human health. The metallic pollution of the Moroccan Atlantic coast between Kenitra and Temara (where the Bou Regreg River flows between the towns of Rabat and Sale and the Sebou RIver near Mehdia) was studied for 18 months. The coastal samples from the ecosystem (mussel and sediments) were collected regularly at low tide. Cadmium, copper, lead and zinc were analyzed by flame atomic spectrophotometry. According to the metallic concentrations for analyzed samples, the following hierarchy was established: (1) mussels; Zn > Cu > Pb > Cd, (2) shells of mussels; Zn > Pb > Cu > Cd, (3) sediments; Zn > Pb > Cu > Cd. The heavy metals were processed by correspondence factorial analysis and by ascending hierarchical classification. Analysis of the results reveals a very important chemical bioaccumulation in the filtering mollusks and sediments. (Author's abstract)
W90-00444

ESTIMATION OF MIXING RATES IN WESTERN LAKE ONTARIO SEDIMENTS BY FINITE ELEMENT ANALYSIS OF 210PB PROFILES.
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2J.
W90-00447

IMPACT OF TOXIC CHEMICALS ON LOCAL WASTEWATER TREATMENT PLANT AND THE ENVIRONMENT.
Toledo Univ., OH.
G. F. Bennett.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 201-212, May-June 1989. 2 fig, 12 tab, 15 ref.

Descriptors: *Water pollution effects, *Toxic wastes, *Wastewater treatment, *Pretreatment of wastewater, *Environmental effects, Biological wastewater treatment, Regulations, Sewers, Toxicity.

Because toxic chemicals being discharged to sewers were simultaneously interfering with wastewater treatment processes of municipal, biological treatment plants and were passing through these plants to negatively impact the bodies of water to which these plants were discharging, the U.S. Environmental Protection Agency issued regulations governing industrial discharges to municipal sewers. These 'Pretreatment Regulations' limit industrial discharges to municipal sewers of heavy metals, oil and grease, acids and bases, and toxic organic chemicals. The evolution of these regulations is discussed, along with the basis for the regulations, the types of regulations (categorical and local), and the rationale for the promulgation based on the impacts of toxic chemicals on the treatment plant and receiving system. Finally, the expected results of these regulation in reducing industrial discharges of toxic chemicals is discussed. The primary emphasis of the program is to control the discharge of toxic substances into the environment. Most toxic substances that enter a publicly operated treatment works (POTW) either leave in the effluent or are concentrated in the sludge. Regulations are needed to control the amount of sludge contaminants, and the pretreatment program will have a major impact on the quality of sewage sludge by removing (or eliminating) potential contaminants at the source (and before the wastewater reaches the sewer). Wastewater contamination can have serious impacts on the operation of a POTW and the sewer lines leading to it. Low pHs will seriously deteriorate concrete sewer lines. The potential acidification could occur in the sewer with conversion of the cyanide ion to toxic HCN gas. Oil and grease discharges present a potential for blockages or fire and/or explosion. Heavy metals and organics may inhibit biological processes and/or contaminate the sludge. Ultimately, the EPA estimates that full implementation of the pretreatment regulations for existing sources will bring about a reduction of 94% of the heavy metals and 47-60% of the primary organics discharged to sewers. (Miller-PTT)
W90-00448

INNOVATIVE HYDROGEOLOGIC SETTING FOR DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES.
For primary bibliographic entry see Field 5E.
W90-00451

ANAEROBIC BIODEGRADATION OF NITROGEN-SUBSTITUTED AND SULFONATED BENZENE AQUIFER CONTAMINANTS.
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
E. P. Kuhn, and J. M. Suflita.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 121-133, Spring 1989. 4 tab, 56 ref. EPA assistance agreements no. CR-812808 and CR-813559.

Descriptors: *Fate of pollutants, *Biodegradation, *Aquifers, *Groundwater pollution, *Hazardous materials, *Benzenes, Anaerobic metabolism, Methane, Nitrogen, Contamination, Sulfates.

A literature survey of ground water contaminants indicated that aquifers are repositories for hazardous wastes, including N-substituted and S-substituted benzene derivatives. The susceptibility of several anilines, benzamides, benzenesulfonic acids and benzenesulfonamides to anaerobic metabolism by aquifer microorganisms was examined. Under sulfate-reducing and methanogenic conditions, the carboxylated anilines were biotransformed within 1 to 3 months while unsubstituted or methylated anilines required longer incubation times. Benzamide as well as an aryl methyl and an N-methyl derivative were biodegraded under both redox conditions. The anaerobic degradation of the N-methylated benzamide was favored in sulfate-reducing rather than methanogenic incubations. However, the addition of a second N-alkyl group rendered the resulting compounds resistant to anaerobic decay. Only 1 of 7 bensenesulfonates and 2 of 5 benzenesulfonamides proved amenable to anaerobic metabolism. It was found that 37-75% of the theoretically expected amount of the methane from aquifer slurries amended with the aminobenzoic acids, benzamide, and p-toluamide. In the sulfate-reducing aquifer slurries, 89-100% of the oxidized benzamide, p-toluamide and N-methylbenzamide could be accounted for by sulfate reduction. These results help indicate which hazardous waste constituents will likely persist in anoxic aquifers and the types if chemical substitution patterns that favor anaerobic biotransformation. (Author's abstract)
W90-00462

IDENTIFICATION OF TRIS(CHLOROPHENYL)METHANOL IN BLUBBER OF HARBOR SEALS FROM PUGET SOUND.
California Univ., Santa Cruz. Inst. of Marine Sciences.
W. Walker, R. W. Risebrough, W. M. Jarman, B. W. de Lappe, and J. A. Tefft.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1799-1804, 1989. 4 fig, 6 ref.

Descriptors: *Seals, *Bioaccumulation, *Organic compounds, *Chlorinated hydrocarbons, *Halogenated pesticides, *Water pollution sources, Pollutant identification.

A compound detected in extracts of blubber of harbor seals, Phoca vitulina, found dead in Puget Sound in the northwestern United States over the period 1972-1982 was identified as tris(chlorophenyl)methanol from its mass spectral characteristics and by synthesis. Concentrations in harbor seal blubber ranged from 23 to 750 nanograms/g of the lipid weight and showed no evident changes over the time interval of the study. Concentrations were highly correlated with those of most of the other organochlorines detected in the harbor seal extracts, indicating a similar pattern of uptake and accumulation. The compound is used in the manufacture of optically active polymers which appear to be a plausible source of this pollutant in the environment. (Author's abstract)
W90-00471

AQUEOUS PHOTOLYSIS OF THE IRON (III) COMPLEXES OF NTA, EDTA AND DTPA.
Swedish Environmental Research Inst., Stockholm.
A. Svenson, L. Kaj, and H. Bjoerndal.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1805-1808, 1989. 2 fig, 1 tab, 13 ref.

Descriptors: *Photolysis, *Iron, *Detergents, *Biodegradation, *Fate of pollutants, Sweden, Degradation.

The rate of photolysis of iron complexes with three common complexing agents, nitrilo-triacetic acid (NTA), ethylenediaminine-tetraacetic acid (EDTA) and diethylenetriamine-pentaacetic acid (DTPA) was analyzed. Aqueous solutions of each complex were illuminated in a Xenotest 1200. Using a sun spectrum from 60 degrees N (Stockholm latitude), environmentally related half lifetimes were 43, 11 and 8 min for the three 1:1 complexes (NTA, EDTA, and DTPA, respectively) dissolved in the top layer of a water system and illuminated at the yearly maximum of sun light in the specified area. In the environment several factors operate to reduce this rate, such as the daily and yearly periodicity of incident light, weather conditions like cloudiness, shadowing effects of surface and shore vegetation, absorption and scattering by suspended solids, dissolved organic compounds and planctic organisms. However, photolytic degradation pathways seem to be an important environmental fate of these substances. (Author's abstract)
W90-00472

VERTICAL DISTRIBUTION OF ALIPHATIC AND AROMATIC HYDROCARBONS IN MUSSELS FROM THE AMPOSTA OFFSHORE OIL PRODUCTION PLATFORM (WESTERN MEDITERRANEAN).
Centro de Investigacion y Desarrollo, Barcelona (Spain). Environmental Chemistry Dept.
M. Soler, J. O. Grimalt, and J. Albaiges.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1809-1819, 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Path of pollutants, *Mussels, *Bioaccumulation, *Oil pollution, *Aliphatic hydrocarbons, Mediterranean Sea, Aromatic compounds, Water pollution sources, Spatial distribution.

The qualitative distributions of aliphatic hydrocarbons in mussels adhered to the legs of an oil production platform (Amposta, Western Mediterranean) have evidenced local (diesel oil) and chronic inputs (middle East crude oils) as the main pollutant sources in the area. Quantitative data have shown that aromatic hydrocarbons are selectively accumulated with the age of mussels and are more evenly distributed through the water column. Background concentrations of petrogenic aliphatic hydrocarbons in mussels living in the vicinity of the oil platforms have been established in the range of 25-40 micrograms/g dry weight. (Author's abstract)
W90-00473

SELECTIVE ACCUMULATION OF CHLORINATED PARAFFINS (C12 AND C16) IN THE OLFACTORY ORGAN OF RAINBOW TROUT.
Uppsala Univ. (Sweden). Dept. of Toxicology.
P. O. Darnerud, A. Bergman, B. O. Lund, and I. Brandt.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1821-1827, 1989. 2 fig, 29 ref.

Descriptors: *Trout, *Bioaccumulation, *Chlorinated hydrocarbons, *Toxicity, *Path of pollutants, Biological magnification, Gills, Adsorption, Olfactory organs.

Three C14-labelled polychloroalkanes (C12 and C16), representing low (23% Cl by weight), medium (51%), and highly (68%) chlorinated paraffin (CP) mixtures, were presented to rainbow trout via the water. The uptake in fat-rich tissues was positively correlated to the degree of chlorination of the preparations. All preparations gave rise to a high and selective uptake of radioactivity in the olfactory organ and gills. This selective radiolabelling may reflect a general ability of these organs to enrich xenobiotics from the surrounding water. The olfactory organ may be a hitherto unforseen target for toxic environmental pollutants in fish. (Author's abstract)
W90-00474

AQUEOUS SOLUBILITY AND N-OCTANOL/WATER PARTITION COEFFICIENT CORRELATIONS.
Rhone-Poulenc S.A., Paris (France).
P. Isnard, and S. Lambert.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1837-1853, 1989. 4 fig, 2 tab, 20 ref.

Descriptors: *Hydrocarbons, *Fate of pollutants, *Solubility coefficient, *Theoretical analysis, Model studies, Bioaccumulation, Regression analysis, Mathematical studies.

Various parameters such as the bioaccumulation coefficient or the organic carbon partition coefficient, are required for studying the fate of chemicals in the environment. The literature offers about fifteen cases of correlations between solubility and n-octanol/water partition coefficient with, for some of them, and for solids, a third variable: the fusion point. However, the coefficients are often the results of theoretical considerations and the size of the data base is often small. A study conducted on 300 products showed the importance of the size of the data base. The coefficients obtained in practice were different from those which had been calculated theoretically. In particular, the introduction of a fusion point correction appears to be justified only to a limited extent. Progress towards developing reliable correlations between octanol/water partition coefficients and solubility must involve statistical regression of large data bases and completed theoretical analyses to suggest the correct form of the correlation equation and provide insights into the reason for the magnitude of the parameter values and their variability. (Geiger-PTT)
W90-00475

RELATION BETWEEN THE MOLECULAR STRUCTURE AND THE ADSORPTION OF ARYLCARBAMATE, PHENYLUREA AND ANILIDE PESTICIDES IN SOIL AND MODEL ORGANIC ADSORBENTS.
Institut de Recherches Chimiques, Tervuren (Belgium).
L. Pussemier, R. De Borger, P. Cloos, and R. Van Bladel.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1871-1882, 1989. 6 tab, 15 ref.

Descriptors: *Path of pollutants, *Adsorption, *Pesticides, *Aromatic compounds, *Molecular structure, Carbamate pesticides, Soils, Model studies, Organic compounds, Peat soils, Soil types, Sand, Silt, Fate of pollutants.

The adsorption behavior of 12 aryl N-methylcarbamates in a few typical agricultural soils (silt, silt loam, sand, sand-podzol) and in a peat were compared by using other molecular parameters in addition to the hydrophobic one. The study was extended to organic adsorbents used in chromatography, as well as to other homologous series of agrochemicals, i.e. 16 phenylureas and 13 anilides. The adsorption experiments were preformed by shaking 1 to 3 g of air-dried soil or 0.1 to 0.5 g of organic adsorbent with 10 ml of the pesticides solution during 2 hr at 25 C. After centrifugation the solute concentration in the supernatant was measured by liquid scintillation technique with the conventional corrections made for quenching. The amount adsorbed was obtained by difference between a blank without adsorbent and the determined equilibrium concentration. The most significant relation was obtained with a multilinear combination of the hydrophobicity constant and the Hildebrand's constant which is influenced by the molecular interactions properties of the aromatic ring of the solutes. (Geiger-PTT)
W90-00476

QUANTIFYING THE SORPTION OF ORGANIC CHEMICALS ON SEDIMENTS.
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
S. M. Schrap, and A. Opperhuizen.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1883-1893, 1989. 2 fig, 4 tab, 27 ref.

Descriptors: *Path of pollutants, *Sorption, *Organic compounds, *Organic carbon, Sediments, Chlorobenzenes, Quantitative analysis, Mathematical studies, Model studies.

Since organic carbon normalized sorption coefficients do appear to be dependent on the type of sediment, and are thus not generally applicable to characterize the sorption properties of chemicals, the use of a reference compound to quantify the sorption of nonpolar organic chemicals is proposed. The hypothesis that nonpolar chemicals sorb in a constant ratio, independent of the sediment, was investigated. Evidence for this hypothesis is shown with data from the literature. The sorption properties of nonpolar compounds on different sediments can be compared if the differences between the sediments are normalized with a reference chemical rather than with the organic carbon content. Sediments with an organic carbon content of less than 0.1% seem to be unsuitable, because the compounds do not sorb mainly on the organic carbon, but also on other parts of the sediment. Sorption coefficients of compounds with aqueous solubilities in the microgram/liter range or octanol-water partition coefficients of more than 100,000 are strongly influenced by the experimental techniques used. For these compounds the sorption coefficients measured by different techniques are less comparable. To enable comparison of sorption coefficients of hydrophobic chemicals, the use of a chlorobenzene as a reference compound in sorption experiments is suggested. (Author's abstract)
W90-00477

INFLUENCE OF CHLORINATION PH AND CHLORINE DOSE ON THE FORMATION OF MUTAGENIC ACTIVITY AND THE STRONG BACTERIAL MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-5(2H)-FURANONE (MX) IN WATER.
Abo Akademi, Turku (Finland). Dept. of Organic Chemistry.
For primary bibliographic entry see Field 5F.
W90-00478

PARAMETERS FOR PREDICTING FATE OF ORGANOCHLORINE PESTICIDES IN THE ENVIRONMENT: I. OCTANOL-WATER AND AIR-WATER PARTITION COEFFICIENTS.
Yokohama National Univ. (Japan). Dept. of Material Science and Chemical Engineering.
Kawamoto, and K. Urano.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1987-1996, 1989. 6 fig, 3 tab, 26 ref.

Descriptors: *Chlorinated hydrocarbons, *Halogenated pesticides, *Fate of pollutants, Solubility coefficient, Air-water interfaces, Adsorption, Insecticides, Fungicides, Biodegradation.

Octanol-water partition coefficients and air-water partition coefficients of 10 principal organochlorine pesticides (thiobencarb, chloropicrin, chlorothalonil, chlornitrofen, fenvalerate, quintozene trichlorfon dichlorvos, tetrachlorophthalide, and DCIP) were obtained as basic data for predicting their fate in the environment. The octanol-water partition coefficients were in the wide range from 10 to 1,000,000 and approximately correlated with the solubilities in water. The air-water partition coefficients were also in the wide range from .0000001 to .01 and the values for chloropicrin, dichlorvos, DCIP and quintozene were relatively high. (Author's abstract)
W90-00480

CONTAMINATION OF FISH BY 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN: A SURVEY OF FISH FROM MAJOR WATERSHEDS IN THE UNTIED STATES.
Environmental Research Lab.-Duluth, MN.

For primary bibliographic entry see Field 5C.
W90-00481

TRIBUTYLTIN IN THE ENVIRONMENT--SOURCES, FATE AND DETERMINATION: AN ASSESSMENT OF PRESENT STATUS AND RESEARCH NEEDS.
Station Federale de Recherches en Arboriculture, Viticulture et Horticulture de Waedenswil (Switzerland).
M. D. Mueller, L. Renberg, and G. Rippen.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 2015-2042, 1989. 1 tab, 100 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Pesticides, *Fate of pollutants, *Pollutant identification, Metals, Toxicity, Aquatic life, Bioaccumulation, Degradation, Sediments, Sludge, Gas chromatography, Tin, Tributyltin.

The present status and the need for further research on toxicity, sources, fate and determination of tributyltin (TBT) in the environment was assessed. Emphasis in this areas has been on information which may have an impact on the regulation concerning the use of TBT. The evaluation of available data shows that the toxicity of TBT towards aquatic organisms, which tend to be the most exposed and sensitive, is well documented. The main release of TBT progresses into the aquatic environment. No significant reduction of TBT levels in the technosphere (e.g. sewage treatment plants) is supposed to occur. Degradation of TBT in the aquatic environment is a slow process. Half-lives range from 1 to 3 weeks under optimal conditions to several years under anaerobic conditions. TBT accumulates in sewage sludges, sediments and biota. High residue levels in sewage sludge indicate sources other than antifouling paints. The present situation of TBT pollution in the aquatic environment is reflected in several recent publications. Levels of TBT determined in surface water are often higher than the no observed effect levels for sensitive stages of aquatic organisms. There is still a lack of knowledge of TBT levels in most compartments of the environment. Analytical methods are available for the determination of TBT and its degradation products at trace levels. A preferred method is gas chromatography combined with a highly specific and sensitive detector. In this respect, interlaboratory comparisons and quality assurance programs are recommended. (Author's abstract)
W90-00482

BUTYLTINS IN SEDIMENTS FROM BOSTON HARBOR, USA.
Massachusetts Univ. at Boston. Environmental Science Program.
N. S. Makkar, A. T. Kronick, and J. J. Cooney.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 2043-2050, 1989. 1 fig, 1 tab, 21 ref. MIT Sea Grant College Grant No. 5-21092.

Descriptors: *Path of pollutants, *Boston Harbor, *Marine sediments, *Water pollution sources, *Boating, Fate of pollutants, Degradation, Massachusetts, Tributyltin.

Sediments from 12 sites in Boston Harbor collected during the winter, summer and fall of 1988 were assayed for butyltin (TBT) by atomic absorption spectrophotometry. The highest levels of TBT were found at sites where commercial or pleasure boats were moored, where ocean going vessels dock, and at a former shipyard. Little or no TBT was detected at sites which do not have a history of significant boating activity. Dibutyltin and monobutyltin were also detected at most sites, indicating that degradation of TBT occurs at these sites. Although microbial action is regarded as the chief mode of degradation, chemical and photochemical processes may also be involved. (Author's abstract)
W90-00483

BIOACCUMULATION AND ELIMINATION OF TETRACHLOROBENZYLTOLUENE (TCBT) BY THE RAT AND BY FISH.
Centre d'Application de Levallois, Levallois-Perret (France). Analytical Dept.
M. Bouraly, and R. J. Millischer.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 2051-2063, 1989. 4 fig, 5 tab, 15 ref.

Descriptors: *Bioaccumulation, *Polychlorinated biphenyls, *Rodents, *Fish, *Path of pollutants, Toxicity, Depuration.

A comparative study has been made of the bioaccumulation and elimination by fish and the rat of tetrachlorobenzyltoluene (TCBT), a substance recently proposed as a substitute for polychlorobiphenyl (PCB), and DP5, a pentachlorobiphenyl mixture (PCB-5 Cl). The study relating to fish (Brachydanio rerio) comprised a 30-day accumulation period followed by a 30-day elimination period. Nominal concentrations of TCBT and PCB-5 Cl, respectively, in the water, were 1 mg/liter in both cases. The study relating to the rat comprised a 90-day treatment period followed by a 30-day elimination period. The animals were exposed by oral (gavage) to doses of 0, 5, 30, and 200 mg/kg/day in the case of TCBT and to the single dose of 5 mg/kg/day in the case of PCB-5 Cl. Concentrations of TCBT and PCB-5 Cl in rat liver and fats, in whole body tissues of fish and in water were measured by gas chromatography, using an electron capture detector. Results showed a clear difference between TCBT and PCB-5 Cl. In fish, bioaccumulation of TCBT was relatively slight and the 50% depuration time was approximately 26 days; in rat liver and fats, TCBT was also only weakly accumulated and rapidly eliminated. This contrasted sharply with the findings for PCB-5 Cl, namely high accumulation potential and slow elimination. Observed rates of bioaccumulation and elimination of TCBT and PCB-5 Cl by the rat were in good agreement with the toxicological findings for the same species. (Author's abstract)
W90-00484

PCBS AND DDT IN SAGINAW BAY WHITE SUCKERS.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. W. Kononen.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 2065-2068, 1989. 2 tab, 3 ref.

Descriptors: *Sucker, *DDT, *Polychlorinated biphenyls, *Path of pollutants, Halogenated pesticides, Chlorinated hydrocarbons, Bays, Great Lakes, Fish.

Fillets from 25 white suckers (Catostomus commersoni) obtained from the Saginaw Bay, Lake Huron commercial fishery in the fall of 1979 and the spring of 1980 were analyzed for polychlorinated biphenyls (PCBs) and total DDT (DDE, DDD, and DDT) by gas chromatography. PCB levels ranged from 0.01-0.18 ppm while total DDT levels ranged from < 0.001-0.044 ppm. These results combined with previous survey data, indicate steady declines in the levels of these contaminants in Saginaw Bay suckers. (Author's abstract)
W90-00485

PHOTODEGRADATION OF 2-ETHOXY- AND 2-BUTOXYETHANOL IN THE PRESENCE OF SEMICONDUCTOR PARTICLES OR ORGANIC CONDUCTING POLYMER.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
For primary bibliographic entry see Field 5D.
W90-00492

REMOVAL OF COPPER FROM SOLUTION USING MOSS.
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W90-00496

EFFECT OF PARTICLE SIZE, CHEMISTRY AND MINERALOGY OF RIVER SEDIMENTS ON PHOSPHATE ADSORPTION.
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Geography.
M. Stone, and A. Mudroch.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 501-510, May 1989. 3 fig, 4 tab, 17 ref.

Descriptors: *Path of pollutants, *Nutrients, *Particle size, *Phosphates, *Lake Erie, *Adsorption, *Fate of pollutants, Sediment transport, Phosphorus, Lake sediments, Minerals, Fluvial sediments.

Laboratory experiments studying the adsorption of inorganic phosphate on separated particle size fractions of two river sediments from the drainage basin of Lake Erie suggested that particle size had no effect on the adsorption of phosphate. Chemical composition and mineralogy are the important parameters controlling adsorption-desorption of phosphates on solid particles present in sediments. Adsorption data for all particle size fractions of quartz, used as a control material, and sediments showed a general pattern: with an increasing concentration of P in water the amount of the adsorbed P increased. Particles between 34 and 500 micrometers exhibited the lowest adsorption. The finest particle size fraction, in this study the < 13 micrometer particle size fraction, was the most active in phosphate adsorption/desorption, and subsequently may play an important role in influencing the availability of this nutrient for biotic uptake in lakes. During high discharge many rivers in southwestern Ontario have elevated levels of dissolved inorganic P and, according to this study, increased adsorption of P onto the < 13 micrometer sediment particle size fraction would occur. However, upon transport of this sediment fraction into a lake with low concentrations of dissolved P (10 to 30 micrograms P/liter), there is a potential for sediment-associated P to desorb in the lake water thus increasing the concentration of soluble P in the lake. The < 13 micrometer particle size fraction in tested tributary sediments contained efficient adsorbers, particularly clays, mainly kaolinite, illite, pyrophyllite, Fe and Mn oxides/hydroxides and organic matter. The methodology developed in this study for the investigation of phosphate adsorption on individual particle size fractions of river sediments in a Lake Erie drainage basin can be used for further investigation of other nutrients and contaminants associated with river and lake sediments. Results obtained in phosphate adsorption experiments by this study may have potential use in models which predict the capacity of sediment to supply P to phytoplankton and to calculate available P target loads for lakes. (Author's abstract)
W90-00503

PREDICTING THE AVERAGE MOVEMENT OF REACTIVE SOLUTES IN SOILS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
W. J. Bond, and D. E. Smiles.
Soil Use and Management SUMAEU, Vol. 4, No. 4, p 115-120, December 1988. 4 fig, 2 tab, 17 ref. Australian Water Research Advisory Council Project No. 84/164.

Descriptors: *Path of pollutants, *Mathematical studies, *Solute transport, *Soil water, *Infiltration, *Adsorption, Anions, Chlorides, Drainage, Mathematical models, Ion exchange.

Simple equations are presented to predict the movement of a solute front in response to a given net cumulative flux of water. These equations do not require the assumption that the water content is at field capacity following water inflow, but may be simplified to that case. Equations are presented both for inert solutes and for anions and cations that react with soils through which they pass. The use of the equations is illustrated with simple hypothetical examples and, in one case, with field data for the movement of sodium chloride. The equations may also be inverted to calculate net drainage fluxes if the mean position of a tracer is known and is below the root zone. (Author's abstract)
W90-00506

METAL POLLUTION OF RIVER MSIMBAZI, TANZANIA.
Tropical Pesticides Research Inst., Arusha (Tanzania).

J. Ak'habuhaya, and M. Lodenius.
Environment International, Vol. 14, No. 6, p 511-514, 1989. 1 fig, 2 tab, 17 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Tanzania, *Stream pollution, *Bioaccumulation, *Pollutant identification, Mercury, Chromium, Copper, Zinc, Iron, Nickel, Cadmium, Manganese, Aluminum, Sediments.

The Msimbazi River in Dar es Salaam, E. Tanzania is polluted with industrial, urban, and agricultural waste waters. A preliminary investigation on the extent of metal pollution (Hg, Cr, Cu, Zn, Fe, Ni, Cd, Mn, Al) was made from samples of sediments and biological indicators. There were in general only moderate variations between the metal contents at different sampling sites. However, the samples from Luhanga River and the upper part of Msimbazi River usually contained lower metal concentrations than samples collected further downstream. The mercury content in all samples was generally low and comparable with data from other areas while the chromium level in the sediments is rather low compared with other rivers. The mean copper content of sediment was near background values from other countries. There was a wide variation in the zinc sediment concentrations, but no significant pollution source was indicated. The iron contents also showed a wide variation in both sediments and plants. Mean nickel and cadmium sediment concentrations were at the same level as reported for other areas. Aluminium contents of both sediment and biological samples were highly variable. A comparison with existing data showed that the metal contents in the River Msimbazi ecosystem were, on the average, normal. (White-Reimer-PTT)
W90-00511

HEAVY METALS IN WATER, SEDIMENTS, PLANTS AND FISH OF KALI NADI U.P. (INDIA).
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, R. Uddin, and A. Khan.
Environment International, Vol. 14, No. 6, p 515-523, 1989. 1 fig, 5 tab, 52 ref.

Descriptors: *Water pollution sources, *Heavy metals, *India, *Stream pollution, Pollutant identification, Sediments, Plants, Fish, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Nickel, Lead, Zinc.

The distribution of heavy metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn,) in the water, sediments, plants, and fish samples collected from the Kali Nadi (India) were determined. The results showed there was considerable variation in the concentration of heavy metals from one sampling station to another which may be due to the variation in the quality of industrial and sewage wastes being added to the river at different places. The following conclusions were drawn based on the pooled results of the concentrations of the metals sampled in the water and sediments: (1) The concentration of cadmium in sediments is independent of its concentration in the surrounding water; (2) The concentration of iron, manganese, nickel, copper, and zinc in sediments tends to increase as the concentration of the corresponding metal increases in the surrounding water; and (3) There is no clear cut trend indicated between the concentration of lead, chromium and cobalt in sediments and the concentration of the corresponding metal in the surrounding water. No such conclusions about the concentrations of these metals in fish with respect to the corresponding concentrations in either the sediments or surrounding water can be drawn due to the few number of observations. (Author's abstract)
W90-00512

CONTAMINATION OF SOIL AND PLANT BY RECYCLING OF SCRAP PLASTICS.
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
V. W. D. Chui, G. Y. S. Chan, Y. H. Cheung, and M. H. Wong.
Environment International, Vol. 14, No. 6, p 525-529, 1989. 1 fig, 5 tab, 22 ref.

Descriptors: *Wastewater pollution, *Heavy metals, *Hong Kong, *Plastics, *Water pollution sources, Runoff, Nickel, Copper, Manganese, Aluminum, Lead, Fishkill, Vegetation.

The effects on a pond of a small factory that recycled plastics by removing metals from plated surfaces with acid were investigated. The rinsing water from the factory was discharged into an old fish pond, eventually causing fish-kills in a number of nearby fish ponds and affecting vegetable cultivations in fields on the downhill side of the factory due to runoff. Both vegetation and sediments were sampled at ten sites, and analyzed for heavy metals using inductively coupled plasma emission spectrophotometry. Nine sites showed various degrees of contamination and the remaining site was unaffected and used as a control. The most polluted site contained 385 mg/kg Ni and 194 mg/kg, Cu (total contents in soil), compared with the control site which contained 12 mg/kg Ni and 9 mg/kg Cu. It was also noted that the metal uptake by the water spinach, Ipomoea aquatica, was significantly correlated to the contents of exchangeable metals (extracted by 1M ammonium acetate in the soil). Several grass species thriving in the polluted areas also had high concentrations of Ni and Cu, as well as other metals such as Mn, Al and Pb in their tissues. (Author's abstract)
W90-00513

MICROORGANISMS: INDICATORS OF POLLUTION IN INTEGRATED LIVESTOCK-FISH FARMING SYSTEMS.
Central Luzon State Univ., Munoz (Philippines).
For primary bibliographic entry see Field 5A.
W90-00514

REMOVAL OF SOME HEAVY METALS FROM POLLUTED WATER BY AQUATIC PLANTS: STUDIES ON DUCKWEED AND WATER VELVET.
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
For primary bibliographic entry see Field 5D.
W90-00528

WATER SOLUBILITY ENHANCEMENTS OF DDT AND TRICHLOROBENZENE BY SOME SURFACTANTS BELOW AND ABOVE THE CRITICAL MICELLE CONCENTRATION.
Geological Survey, Denver, CO.
D. E. Kile, and C. T. Chiou.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 832-838, July 1989. 8 fig, 2 tab, 18 ref.

Descriptors: *Water pollution sources, *Pesticides, *Surfactants, Micelles, Solubility, DDT, Trichlorobenzenes, Triton X.

Water solubility enhancements of 1,1-bis(p-chlorophenyl)-2,2,2-trichloroethane (DDT) and 1,2,3-trichlorobenzene (TCB) by aqueous surfactants below and above their critical micelle concentrations (CMCs) have been studied at room temperature with the following surfactants: Triton X-100, Triton X-114, Triton X-405, Brij 35, sodium dodecyl sulfate, and cetyltrimethylammonium bromide. While the solubilities of DDT and TCB are greatly enhanced by all surfactants above the measured CMC, DDT also exhibits significant solubility enhancements below the CMC of the molecularly nonhomogeneous surfactants (the Triton series and Brij 35). The plot of the apparent DDT solubility against the concentration of Triton and Brij surfactants shows an uprising curve below the nominal CMC, which is attributed to the successive micellization of the heterogeneous monomer species. Above the CMC, the enhancement effect with the ionic surfactants is less accountable in terms of their nonpolar chain contents. This effect is attributed to a partition-like interaction with the nonpolar content of the dilute surfactant, similar to the enhancement effect caused by dissolved humic materials. The inner nonpolar core of the micellar phase appears to have a high degree of solvency for TCB and DDT in spite of the microscopic size of the micelle. (Author's abstract)
W90-00536

SEQUENTIAL REDUCTIVE DEHALOGENATION OF CHLOROANILINES BY MICROORGANISMS FROM A METHANOGENIC AQUIFER.
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
E. P. Kuhn, and J. M. Suflita.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 848-852, July 1989. 3 fig, 1 tab, 53 ref.

Descriptors: *Biodegradation, *Chlorinated hydrocarbons, *Water pollution treatment, *Chloroanilines, *Dehalogenation, *Wastewater treatment, Methanogenic aquifers, Oxidation, Microorganisms, Groundwater pollution.

Chloroaniline-based compounds are widely used chemicals and important contaminants of aquatic and terrestrial environments. It was determined that chloroanilines can be biologically dehalogenated in polluted aquifers when methanogenic, but not sulfate-reducing conditions prevail. The halogens are replaced by protons in a series of reductive steps catalyzed by microorganisms. The sequential release of halogens from the para and ortho position of 2,3,4,5-tetrachloroaniline (2,3,4,5-tetraCA) resulted in formation of 2,3,5-trichloraniline (2,3,5-triCA) and eventually 3,5-dichloroaniline (3,5-diCA). Similarly, when 3,4-diCA was used as a parent substrate, it was transformed to 3-chloraniline (3-CA). Metabolites and end products were identified by their chromatographic mobility and their mass spectral fragmentation pattern. A strategy for the bioremediation of groundwaters, soils, wastewaters, or other environments contaminated with chloranilines might consist of following a treatment process designed to initially maintain methanogenic conditions with an aerobic incubation phase. During the first, aniline or lesser halogenated anilines would presumably accumulate. The complete oxidation of the latter compounds would occur during the second stage where oxygen would serve both as a coreactant and as an electron acceptor for the catalyzing microorganisms. (Author's abstract)
W90-00538

PREDATION AND INHIBITORS IN LAKE WATER AFFECT THE SUCCESS OF INOCULATION TO ENHANCE BIODEGRADATION OF ORGANIC CHEMICALS.
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
B. R. Zaidi, Y. Murakame, and M. Alexander.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 859-863, July 1989. 6 fig, 15 ref.

Descriptors: *Water pollution treatment, *Biodegradation, *Lake restoration, *Nitrophenol, *Mineralization, *Fate of pollutants, *Organic compounds, *Lake restoration, Corynebacterium, Predation, Inhibition.

p-Nitrophenol (PNP) at 50, 75, and 100 microg/L was mineralized extensively in lake water inoculated with Corynebacterium sp. but not in uninoculated lake water. The bacterium mineralized a far lower percentage of PNP at 26 microg/L than at the higher concentrations. Cycloheximide did not affect mineralization in lake water containing the three higher concentrations, but the extent of mineralization and Corynebacterium sp. numbers at 26 microg of PNP/L were reduced by this eucaryotic inhibitor. Dialysis of lake water did not influence the rate of mineralization of 1.0 mg/L, but it reduced the acclimation period, stimulated Corynebacterium sp., and usually enhanced the rate of its mineralization of PNP at 10 and 26 microg/L. An inhibitor of PNP metabolism and Corynebacterium sp. could be removed from lake water by a cation-exchange resin. A mixed culture mineralized PNP at 26 microg/L faster than Corynebacterium sp. The data show that predation or inhibitors may markedly affect bacteria inoculated into natural waters to promote biodegradation of low concentrations of organic chemicals. (Author's abstract)
W90-00539

DETERMINATION OF HYDROCARBON SOURCES USING N-ALKANE AND POLYAROMATIC HYDROCARBON DISTRIBUTION INDEXES. CASE STUDY: RIO DE LA PLATA ESTUARY, ARGENTINA.
Quebec Univ., Rimouski. Dept. of Oceanography.
J. C. Colombo, E. Pelletier, C. Brochu, M. Khalil, and J. A. Catoggio.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 888-894, July 1989. 4 fig, 3 tab, 40 ref.

Descriptors: *Water pollution sources, *Hydrocarbons, *Argentina, *Hydrocarbons, Distribution indexes, Rio de La Plata, Alkanes, Polycyclic aromatic hydrocarbons, Case studies.

The evaluation of n-alkane and polyaromatic hydrocarbon (PAH) distribution indexes in Rio de La Plata sediments were used to help elucidate the origins of complex hydrocarbon mixtures. N-Alkane indexes allowed the identification of biogenic and petrogenic sources, while PAH ratios were sensitive indicators of petrogenic and pyrogenic inputs. The contribution of naturally derived methylphenanthrenes obscured some PAH ratios. The petrogenic n-alkanes and PAHs characterized by a continuous C14-C33 series and by the abundance of alkylated homologues, respectively, predominate in the heavily contaminated La Plata Harbor area. Offshore stations showed the abundance of terrigenous C23-C33 n-alkanes with marked odd carbon predominance and of pyrogenic PAHs, characterized by the abundance of unsubstituted species. The relative contribution of perylene, as preformed detrital hydrocarbon and 'in situ' diagenetically produced, was prominent in low-contaminated stations. (Author's abstract)
W90-00540

STUDIES ON FAECAL STREPTOCOCCI IN WELLS WATER NEAR MOSUL CITY.
Mosul Univ. (Iraq). Dept. of Biology.
S. H. Khalaf, and A. M. Muhammad.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 5, p 467-475, July 1989. 3 tab, 11 ref.

Descriptors: *Drinking water, *Iraq, *Well water, *Bacterial analysis, *Streptococcus, Bioindicators, Contamination, Feces, Human wastes, Fecal streptococci, Pollution sources.

Eight species and varieties of fecal Streptococci were detected in two hundred water samples collected from fifty-five wells in the vicinity of Mosul City, Iraq. The incidence of species was: S. faecalis, 26%; S. faecalis var. liquefaciens, 4.3%; S. faecalis var. zymogenes, 3.0%; atypical S. faecalis, 13.3%; St. faecium, 1.8%; S. durans, 1.8%; S. bovis, 24.3%; and S. equinus, 25.5%. The specific bacteria found in each sample indicated that 26 (17.4%) were polluted with livestock and poultry feces, 19 (12.8%) were polluted with a mix of pollutants with animal wastes predominant, 52 (34.9%) were polluted with a mix of pollutants with human wastes predominant, 20 (13.4%) were polluted with pure human feces, and 32 samples showed uncertain meaning. Of the 200 water samples studied, 149 (74.5%) were polluted. Statistical analysis showed a significant positive correlation between pollution sources and the area from which the samples were collected. It is thought that faulty well construction and improper well location are responsible for the high level of pollution. (White-Reimer-PTT)
W90-00543

STATE OF AN ARID IRRIGATION RESERVOIR STALKED WITH WASTEWATER EFFLUENT AND STORM INDUCED FLOWS.
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
A. B. M. Shahalam, and A. R. Mansour.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 5, p 477-504, July 1989. 6 fig, 9 tab, 15 ref.

Descriptors: *Water pollution sources, *Reservoirs, *Irrigation water, *Jordan, Wastewater irrigation, *Water reuse, Reservoir input and output data, Storm runoff, Water chemistry, Sodium, Adsorption, Zarqa River.

The results of a sequential analysis of input and output data monitored in a typical wastewater fed reservoir, King Talal Reservoir, located about 35 km north of the city of Amman, Jordan on the Zarqa river are presented. The main purpose of the reservoir was for irrigation, municipal and industrial water, and hydroelectric power. The main sources of reservoir water are storm induced runoff and sewage effluent from municipalities and industries. Wastewater effluent from the Amman wastewater treatment plant is directly discharged into Zarqa river which flows into the reservoir. Weekly sampling data from four sites were averaged monthly for the years 1981 and 1982. Parameters included were: flow, temperature, pH, dissolved oxygen, BOD, solids, conductivity, nitrogen, phosphorus, chloride, sulfate, calcium, magnesium, sodium, and chlorophyll. The inflow of the reservoir during the dry months is mainly from wastewater effluent. The results indicate that the reservoir is retaining significant amounts of total dissolved solids, nitrogen, P2O5, chloride, SO4, Ca, Mg, and Na; and releases BOD5, total suspended solids, and chlorophyll a. Since the reservoir water is used mainly for irrigation, the water quality appears to be perfectly satisfactory for this use. The sodium adsorption ratio values for the reservoir water remained low during the dry and wet period of the year. Therefore, the project of storing wastewater along with stormwater and their subsequent uses for irrigation is a success, and does not cause any harmful effects on the water quality and viability of the reservoir. (White-Reimer-PTT)
W90-00544

SCIENTIFIC BASIS FOR ECOLOGICAL STANDARDS GOVERNING ANTHROPOGENIC EFFECTS ON THE MARINE ECOSYSTEMS AS EXEMPLIFIED BY THE BALTIC SEA.
Obshchesoyuznyi Gosudarstvennyi Komitet SSSR po Gidrometeorologii i Kontrolyu Prirodnoii Stredii, Moscow.
Y. A. Izrael, A. V. Tsyban, M. V. Venttsel, and V. V. Shigayev.
Oceanology ONLGAE, Vol. 28, No. 2, p 226-231, 1988. 5 tab, 33 ref.

Descriptors: *Baltic Sea, *Heavy metals, *Polychlorinated biphenyls, *Water pollution effects, *Fate of pollutants, Benz(a)pyrene, Mass balance, Model studies, Assimilation capacity, Maximum permissible concentration.

The practical determination of the assimilation capacity of an ecosytem for specific pollutants using a generalized model to make the first estimate of the assimilation capacity of the Baltic Sea for both toxic metals (i.e., zinc, copper, lead, cadmium and mercury) and organic pollutants (i.e., polychlorinated biphenyls (PCBS) and benz(a)pyrene) is discussed. The assimilation capacity of marine ecosystems can be determined by means of a generalized model the includes three blocks: (1) calculating the mass budget and 'lifetime' of pollutants in the ecosystem; (2) analysis of the biotic balance in the ecosystem; and (3) evaluation of the 'critical' concentrations (or ecological maximum permissible concentration) at which the pollutants affect the functioning of the biotic component. The estimates of the assimilation capacity of large zones in the open area of the Baltic Sea for the most dangerous pollutants indicate that the current discharges of zinc, cadmium and mercury still pose no direct danger to the reproduction of the sea's biological resources. The calculations indicate that additional research on the biochemical cycles of copper and zinc must be made and that special measures to limit their discharge into the ecosystem of the Baltic Sea may be necessary. (White-Reimer-PTT)
W90-00548

TRACE ELEMENTS IN THE ECOSYSTEM OF PETR VELIKIY GULF.
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
G. N. Sayenko, L. G. Zorina, R. O. Radkevich, T. A. Biryukova, and A. V. Karyakin.
Oceanology ONLGAE, Vol. 28, No. 2, p 249-256, 1988. 3 tab, 16 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Trace elements, *Bioindicators, *Bioaccumulation, *Sea of Japan, Marine algae, Mollusks, Seasonal variation, Sediments, Pollutant identification, Water analysis.

The concentrations of heavy metals (Cr, Mn, Fe, Co, Ni, Cu, Zn, No, Sn, Cd, Pb) and precious metals (Ag, Au) and of Al and Si in marine environments near islands in Petr Velikiy (Peter the Great) Gulf (Sea of Japan) were studied by emission spectral analysis, atomic absorption spectroscopy and neutron activation analysis. Seasonal variations of the microelements were found in macrophytes sampled, and concentrations were higher near ore veins on the eastern side of the island. Seasonal variation was also observed in the mollusks with concentrations expressing the geochemical composition of the water and human impacts. The concentration of trace elements of the bottom sediments depended both on the composition of the underlying rock and the nature of the river discharge and the biological structure of the water area. The concentrations of Fe, Co, Ni, and Mo in the sediments was correlated with amounts of these elements in plants and mollusks. The determinations of the trace element composition of marine plants, mollusks, bottom sediments and water over the course of 4 years indicated that certain representatives of the marine biota, i.e. Gray's mussel (Grenomytilus grayanus), the brown algae (Laminaria cichorioides and L. japonica), and the sea grass (Phyllospadix iwatensis) can indicate elevated concentrations of certain elements and can thus indicate the metallogenic situation in the area. (White-Reimer-PTT)
W90-00549

PISCINE BIOCONCENTRATION CHARACTERISTICS OF CYCLIC AND LINEAR OLIGOMERIC PERMETHYLSILOXANES.
Dow Corning Corp., Midlands, MI. Health and Environmental Sciences Dept.
R. B. Annelin, and C. L. Frye.
Science of the Total Environment STENDL, Vol. 83, No. 1-2, p 1-11, July 1, 1989. 3 fig, 1 tab, 12 ref.

Descriptors: *Path of pollutants, *Fish physiology, *Permethylsiloxanes, *Bioaccumulation, Surfactants, Resaturation method, Molecular weight effects, Micelles.

Uptake of permethylsiloxanes by rainbow trout and fathead minnows was measured and compared using a conventional 'resaturation' method. Although cyclic Me2SiO-oligomers accumulated to a greater extent in fish than did comparable linear oligomers, uptake decreased sharply with increasing molecular weight. Thus, in the cyclic series (D sub x), order of magnitude decreases were observed for each incremental molecular weight increase i.e. for the compounds D sub 4, D sub 5, and D sub 6 uptake levels of approximately 200, 20, and 2 ppm, respectively were observed. In the linear series, uptake of the tetramer MDsub2M was an order of magnitude less than observed for D sub 4 and little or no uptake (< 0.5 ppm) was observed for MDsub3M, MDsub4M and MDsub7M. Very similar uptake levels of D sub 5 resulted with and without a surfactant, even though the surfactant afforded a 20-fold increase in the D sub 5 content of the water. This finding suggests that bio-availability is defined by the amount present in true solution as individual molecules and is not affected by the presence of aggregates or micelles. The highly inverse relationship observed in this study between uptake and molecular weight is strongly supportive of earlier estimates of a limiting molecular weight of about 600. (Author's abstract)
W90-00553

ACCUMULATION OF ORGANOTINS IN ADULT AND SEED OYSTERS FROM SELECTED ESTUARIES PRIOR TO THE INTRODUCTION OF U.K. REGULATIONS GOVERNING THE USE OF TRIBUTYLTIN-BASED ANTIFOULING PAINTS.
Plymouth Polytechnic (England). Dept. of Envi-

ronmental Sciences.
L. Ebdon, K. Evans, and S. Hill.
Science of the Total Environment STENDL, Vol. 83, No. 1-2, p 63-84, July 1, 1989. 4 fig, 4 tab, 14 ref.

Descriptors: *Oysters, *Pesticides, *Antifoulants, *England, *Organotins, *Biological magnification, *Bioaccumulation, Estuaries, Tributyltin, Monobutyltin, Seed oysters, Shell thickness, Seasonal variation, Atomic absorption spectrophotometry, Organotin compounds.

Between April and November, 1985, a study of the levels of organotins in adult and seed Crassostrea gigas grown in the southwest and southeast of England was carried out. The analytical procedure used was directly coupled high performance liquid chromatograhpy-flame atomic absorption spectrometry. Individual adult oysters and groups of 20-40 seed oysters were taken for analysis on a monthly basis. In general, levels of all three organotin species were found to be higher in the seed oysters. Mean levels of tributyltin (TBT) reached 3.1 microg/g in seed oysters from the Exe, Devon, in October, whereas mean levels of dibutyltin (DBT) and monobutyltin (MBT) reached 16.1 and 16.7 microg/g in Teign, Devon, seed oysters in October. Bioconcentration factors of approximately 10,000 were found, but seem to be greater when lower levels of TBT were present in the water. The highest percentage of adult oysters with severely thickened shells was found at Tollesbury Fleet, where 61% of oysters showed shell thickness index values of six or less. Generally, two peaks in TBT levels in the oysters were observed, in the late spring and early summer: these seem to correlate with peak levels of TBT in the waters immediately preceding these times. A large proportion of the DBT and MBT found in the oysters seems to come from the metabolism of the TBT ingested. It is suggested that high sediment loadings may contribute to the severe deformation of oysters grown at Tollesbury fleet but only in the presence of TBT. (Author's abstract)
W90-00554

LEACHABILITY AND PARTITIONING OF ELEMENTS IN FERROMAGNETIC FLY ASH PARTICLES.
Alberta Univ., Edmonton. Dept. of Soil Science.
C. J. Warren, and M. F. Dudas.
Science of the Total Environment STENDL, Vol. 83, No. 1-2, p 99-111, July 1, 1989. 1 fig, 3 tab, 26 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Fly ash, *Separation techniques, *Leaching, Ferromagnetic particles, Magnetite, Nitric acid, Aluminum, Calcium, Iron, Potassium, Magnesium, Manganese, Sodium, Silica, Extraction techniques, X-ray diffraction.

Ferromagnetic particles were separated from an alkaline fly ash and following selective sequential extractions were analyzed to determine partitioning of elements among glassy and crystalline phases. Quadruplicate samples of the ferromagnetic fraction were extracted using 0.5 mol/L HNO3 at a solution to solid ratio of 16:1. The non-extracted sample, along with residues which were extracted with 7, 14, 21, and 28 replacements of solution, were analyzed by instrumental neutron activation analysis. Extract solutions were analyzed for content of Al, Ca, Fe, K, Mg, Mn, Na, and Si by atomic absorption spectrophotometry. X-ray diffraction indicated that the ferromagnetic fraction contained little glassy material and was composed chiefly of crystalline magnetite with small quantities of quartz, and haematite. Most ferromagnetic particles comprised three distinct phases: a highly soluble exterior glassy veneer, a crystalline magnetite highly substituted in a variety of metals, and a less soluble aluminosilicate glass interstitial to the magnetite. A unit cell dimension (a) of 838.87 pm was calculated for the fly ash magnetite. The release of constituents during weathering, as simulated with HNO3 leaching, was similar to that previously observed for most aluminosilicate fly ash particles. The majority of the total As, B and Se was associated with the exterior of particles and removed during HNO3 leaching. Elements that commonly substitute for Fe in spinel structures, such as Co, Cr, Mn, Mg and Ni, were enriched in the extracted residues. Elements that do not commonly substitute for Fe in spinel structures were concentrated in the interstitial aluminosilicate material. (Author's abstract)
W90-00555

'RED HERRING' LAKES AND STREAMS IN THE ACID-RAIN LITERATURE.
Norsk Inst. for Vannforskning, Oslo.
S. A. Norton, D. F. Brakke, and A. Henriksen.
Science of the Total Environment STENDL, Vol. 83, No. 1-2, p 113-125, July 1, 1989. 3 tab, 42 ref. U.S. EPA Cooperative Agreement CR812653.

Descriptors: *Acid rain, *Acid lakes, *Data interpretation, Water chemistry, Organic acids, Salt stress, Errors.

Examples of naturally acidic lakes and streams that occur in areas not receiving acid rain are frequently cited in the literature on acidic precipitation. Both organic acidity and the effect of salt have been postulated as explanations for naturally occurring acidity. The example lakes have been presented as being representative of the processes responsible for regionally acidified lakes in Scandinavia and eastern North America. The published water chemistry data for the examples cited have been analyzed and it is concluded that the interpretations are incorrect because of faulty or incomplete chemical analysis, and errors in data compilation, summary, and analysis. Furthermore, the use of analogy is incorrect in some cases because the examples are not representative of lake types in regions where there are large numbers of recently acidified lakes. Organic acidity and the sea-salt effect may contribute to the acid-base status of a lake or stream, but there is no evidence that either one is responsible for the regional and recent chronic acidification observed in lakes and streams in areas of North America and Scandinavia receiving acidic precipitation. These findings emphasize three points: (1) careful scrutiny of water chemistry data before using any part of it; (2) use of information that represents the general case and population level when possible; and (3) clarification and correction of the interpretations that are critical with respect to points originally raised by the investigators. (Author's abstract)
W90-00556

ACTINIDE BEHAVIOR IN NATURAL WATERS.
Florida State Univ., Tallahassee. Dept. of Chemistry.
G. R. Choppin, and B. E. Stout.
Science of the Total Environment STENDL, Vol. 83, No. 3, p 203-216, July 1, 1989. 4 fig, 5 tab, 36 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Actinide elements, *Water chemistry, *Fate of pollutants, *Radioactive wastes, *Plutonium, *Neodymium, *Thorium, *Uranium, Hydrolysis, Complexes, Ligands, Oxidation, Equilibrium constants, Solubility, Ion transport.

The range of potential reactions of actinide elements in natural systems is unusually broad. This is due to the existence of these elements in one or more of four different oxidation states, each with a different set of values for complexation. Hydrolysis, redox, and complexation by carbonate, humics and other natural ligands serve to affect the transport of actinides by natural waters. If plutonium, the element of most concern, is in the IV state, hydrolysis is dominant and leads to high sorption on particulate surfaces. However, if the plutonium is in the V state as PuO(2+), hydrolysis and complexation are minimal and mobility should be high. In this study speciation and solubility calculations have been used to estimate the concentration of neodymium, thorium, and uranium in seawater. These elements can be assumed to have reached saturation (or steady-state concentrations) in the oceans and can serve as analogs for the behavior of the tri-, tetra-, and hexavalent oxidation states of the actinide elements, respectively. These calculations can then be compared with measured concentrations to allow evaluations of (a) the complexation and solubility data, and (b) models which are based on equilibrium with solids and which do not include the effects of sorption to colloids or suspended particles on the solubility. (White-Reimer-PTT)
W90-00558

CHEMICAL AND PHYSICAL CHARACTERISTICS OF RAINFALL IN VENICE: INFLUENCE OF THE SAMPLING METHOD ON THE RELIABILITY OF THE DATA.
Venice Univ. (Italy). Dept. of Environmental Science.
E. Argese, and A. G. Bianchini.
Science of the Total Environment STENDL, Vol. 83, No. 3, p 287-298, July 15, 1989. 7 fig, 2 tab, 14 ref. The Italian National Alternative Energy Authority contract No. 789.

Descriptors: *Water pollution sources, *Venice, *Acid rain, *Italy, *Precipitation, Sulfur compounds, Oxidation, Hydrogen ion concentration, Sodium, Chlorides, Sulfates, Calcium, Ammonia, Neutralization.

A large number of single precipitation event samples were collected in Venice from October 1985 to June 1987 in order to acquire reliable data on the acidity, electrical conductivity, and chemical composition of the rain. The pH values varied from 3.50 to 7.50 with 76% of the values below 5.6 and the most frequent values ranging between 4.2 and 4.4. The influence of sea spray, calcareous airborne particles and the lagoon environment on the chemical composition of the rain was indicated by the correlations between the concentrations of Na(+), Cl(-), SO4(2-), and Ca2(+) ions and the seasonal trend of H(+), SO4(2-), and NH4(+). The following conclusions were determined: (1) sulfur compounds are the most important acidizing components; (2) the SO4(2-) in rain can derive both from the H2SO4 produced by SO2 oxidation as well as from marine spray, where it is present as a salt, and the data indicate that the main source of sulfate is H2SO4, produced by anthropogenic SO2 oxidation; and (3) the net acidity of the rain is determined mostly by the degree of neutralization of sulfuric acid by CaCO3; this alkalizing effect has been found in various zones of the upper Adriatic and is generally ascribed to local geological features. (Author's abstract)
W90-00560

RETENTION OF MERCURY IN SEDIMENTS OF THE BALTIC SEA NEAR OULU, FINLAND.
Joensuu Univ. (Finland). Dept. of Biology.
K. Tolonen, E. Alasaarela, and A. Liehu.
Journal of Paleolimnology, Vol. 1, No. 2, p 133-140, October 1988. 6 fig, 1 tab, 17 ref.

Descriptors: *Path of pollutants, *Mercury, *Finland, *Baltic Sea, *Cores, *Sediments, Fish, Industrial wastes, Accumulation, History.

Several cores were compared to determine the extent of mercury retention in the sediments of the Baltic Sea near Oulu, Finland. Based on the history of a known mercury discharge from a chlor-alkali plant, the primary pollution source, a comparison was made with the mercury in the sedimentary record. One core was dated by lead-210 and varve counts. During the past thirty years, the maximum sedimentation rate was 10 mm per year which corresponds to a dry matter accumulation rate of about 3 kg/sq m/a. Most of the mercury reaching the sediments was retained; however, the mercury levels in fish were considerably lower, with a delay of about five years. The present mercury content of the upper layers is about 1/4 or 1/5 that of the late 1970's, but it is still a twenty-fold increase when compared to levels at the beginning of the century. The extent to which the present mercury level in the sediment represents the various phases of industrial emission remains unsolved due to the origin of mercury in this sea area from several other sources and due to difficulties in exact core correlations from different years. (Author's abstract)
W90-00561

PREDICTION OF SOLUBLE PHOSPHORUS TRANSPORT IN AGRICULTURAL RUNOFF.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, and S. J. Smith.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 313-316, Jul-Sep 1989. 2 fig, 2 tab, 18 ref.

Descriptors: *Phosphorus, *Agricultural runoff, *Eutrophication, *Water pollution sources, Solubility, Sediment-water interfaces, Grasses, Crops, Desorption kinetics, Predictions.

The soluble phosphorus (SP) concentration of runoff for individual events from agricultural land were predicted using relationships describing soil P desorption kinetics and effective depth of surface soil-runoff interaction (E). These values were compared with concentrations measured for runoff from 9 grassed and 11 cropped watersheds in the Southern Plains, USA, over a 10-yr period. Using a constant value of E for a given watershed, measured soluble phosphorus concentrations were overestimated by up to 4415% for runoff events of < 0.75 mm in volume. Using a value of E calculated for each runoff event from soil loss, correlation coefficients between measured and predicted values and prediction errors were improved (R sq = 0.95-0.99 and error = 11-18%) compared to use of a constant E value (R sq = 0.21-0.83 error = 38-380%) averaged for each watershed location. Although these improvements did not significantly (5% level) affect estimates of the amounts of soluble phosphorus transported, the improvements will be important from environmental aspects, in terms of assessing the impact of agricultural management practices on P-related eutrophication for all runoff events. (Author's abstract)
W90-00567

HEAVY METAL ACCUMULATION IN SMALL MAMMALS FOLLOWING SEWAGE SLUDGE APPLICATION TO FORESTS.
Washington Univ., Seattle. Wildlife Science Group.
For primary bibliographic entry see Field 5E.
W90-00570

FIELD APPLICATION OF A FINITE-ELEMENT WATER-QUALITY MODEL TO A COAL SEAM WITH UCG BURNS.
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
D. N. Contractor, and S. M. A. El-Didy.
Journal of Hydrology JHYDA7, Vol. 109, No. 1-2, p 57-64, July 1989. 4 fig, 1 tab, 10 ref. U.S. DOE Contract DE-AC20-84LC11053.

Descriptors: *Groundwater pollution, *Hydrologic models, *Coal mines, *Groundwater movement, *Groundwater quality, Underground coal gasification, Constituent movement, Wyoming.

A two-dimensional finite-element model has been developed to study the flow of water and the transport of water-quality constituents associated with underground coal gasification (UCG) burns in a coal aquifer. The flow model calculates the piezometric head and seepage velocity distributions in the aquifer as a function of time. These outputs are fed into a water quality model that takes into account the dispersion, decay, and sorption characteristics of a particular water quality constituent. These models can be used to study the movement of contaminants within an aquifer. The models have been verified for accuracy by checking their output against analytic solutions that are available for simple aquifer geometries. These programs have been applied to the Hanna UCG burns in Wyoming. Steady-state flows are assumed in the coal seam and the movement of a constituent was studied as a function of time as the five burns were completed. This example illustrates how the model can be used by water-resource managers to understand the environmental impact of UCG burns. (Author's abstract)
W90-00577

GEOLOGICAL FRAMEWORK AND OBSERVED OILSEEPS OF ZAKYNTHOS ISLAND: THEIR POSSIBLE INFLUENCE ON THE POLLUTION OF THE MARINE ENVIRONMENT.
Athens Univ. (Greece). Subfaculty of Earth Sciences.
For primary bibliographic entry see Field 5C.
W90-00625

ZINC MOVEMENT IN SEWAGE-SLUDGE-TREATED SOILS AS INFLUENCED BY SOIL PROPERTIES, IRRIGATION WATER QUALITY, AND SOIL MOISTURE LEVEL.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5E.
W90-00640

ATMOSPHERIC DEPOSITION OF PHOSPHORUS AND NITROGEN IN CENTRAL ALBERTA WITH EMPHASIS ON NARROW LAKE.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-00645

CONTRIBUTION OF MERCURY FROM THERMAL SPRINGS TO THE ENVIRONMENTAL CONTAMINATION OF MT. AMIATA.
Istituto di Biofisica, Pisa (Italy).
C. Barghigiani, B. Z. Siegel, R. Bargagli, and S. M. Siegel.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 169-175, January 1989. 1 fig, 4 tab, 15 ref.

Descriptors: *Water pollution sources, *Italy, *Path of pollutants, *Geothermal studies, *Mercury, *Mine wastes, *Environmental effects, *Thermal springs, Mountains, Air pollution, Water pollution, Soil contamination, Vegetation effects, Canada.

Many cinnabar deposits are located in geothermal areas and it is known that a relationship exists between genesis of the mineral and geothermal activity. However, independently of local geochemical anomalies, many geothermal areas contain high levels of environmental mercury (Hg). Historically Mt. Amiata, Italy, has served as an important source of Hg in the Mediterranean basin. In spite of more than a decade without mining or smelting operations, the areas remain heavily contaminated. Many old mine sites as well as geothermal plumes still exist. A common belief is, however, that the many thermal springs which carry their contents over the mountainous area, constitute a significant source of Hg. A 1987-1988 study of the Hg distribution in air, soil, and vegetation at the Bagno Vignoni and Bagni S. Filippo thermal springs, and at the mining town of Abbadia S. Salvatore has demonstrated that Hg content around the springs was comparable to reported values in areas of little or no contamination, whereas those values found at Abbadia S. Salvatore compare well with high levels reported in the mining community of Fort St. James, British Columbia. (Author's abstract)
W90-00647

BIOTRANSFORMATION OF AROMATICS IN STRIP-PIT POND.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
E. J. Bouwer.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 741-755, August 1989. 4 fig, 7 tab, 19 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Water pollution treatment, *Lake restoration, *Benzenes, *Biotransformation, *Aromatic compounds, Coal mining, Wastewater treatment, Nitrogen, Phosphorus, Hazardous wastes.

A strip-pit pond formed as a result of past coal mining activities in northeastern Ohio is contaminated with alkylbenzenes and chlorobenzene from tank-truck washing operations. Batch aerobic studies were performed on samples from a strip-pit pond containing about 100 micrograms/liter each of chlorobenzene, toluene, ethylbenzene, xylenes, styrene, and aniline in order to determine the potential for their biotransformation under field conditions. Microorganisms capable of biotransforming the aromatic compounds are present in the strip-pit pond water. However, under natural conditions, the biotransformation rate is slow as incomplete removal is observed over a 43-day incubation period. Volatilization rates exceed the natural rates of biotransformation. Addition of acetate, nitrogen, and phosphorus markedly increase the rate of biotransformation of the aromatic compounds. Enhanced biotransformation rates are more than an order of magnitude faster than volatilization rates. Chlorobenzene is mineralized to carbon dioxide. The presence of 0.61 g/L sediment does not significantly affect biotransformation of the aromatic compounds at a 95% level of confidence. The prospect for successfully stimulating and exploiting biotransformation of the contaminants in a bioreclamation scheme appears very good. (Author's abstract)
W90-00657

NUTRIENTS STATUS IN A EUTROPHIC MEDITERRANEAN LAGOON.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 2L.
W90-00671

DDT RESIDUES IN THE FAT OF CROCODILES FROM LAKE KARIBA, ZIMBABWE.
Harbor Branch Oceanographic Institution, Inc., Fort Pierce, FL.
R. J. Phelps, M. Toet, and J. M. Hutton.
Transactions of the Zimbabwe Scientific Association, Vol. 64, No. 2, p 9-14, April 1989, 1 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, Bioaccumulation, *DDT, *Pesticides, *Insecticides, *DDE, *Crocodiles, *Zimbabwe, Ecological effects, Lake Kariba, Fate of pollutants, Gas chromatography.

Residues of DDT and its metabolites were determined by gas chromatography in the body fat of 24 crocodiles from three regions along the northern and eastern shoreline of the eastern end of Lake Kariba. Total DDT levels varied between the three regions. Region 1 had lower levels of most residues while regions 2 and 3 had similar residue levels. The residue levels reflect the use of the pesticide in tsetse fly control operations and in agriculture. Considerable quantities of the insecticidally-active isomer of DDT were found in some samples, indicating current usage of DDT. The bulk of the residues were in the form of the metabolite DDE (2,2-bis-(p-chlorophenyl)-1,1-dichloroethylene). (Author's abstract)
W90-00674

LEAD AND CADMIUM IN STONE LOACH (NOEMACHEILUS BARBATULUS L.) FROM THREE RIVERS IN DERBYSHIRE.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
P. E. T. Douben.
Ecotoxicology and Environmental Safety EESADV, Vol. 18, No. 1, p 35-58, August 1989. 5 fig, 13 tab, 34 ref.

Descriptors: *Path of pollutants, *Fish, *Cadmium, *Lead, *Heavy metals, Loach, Growth, Sediments, Rivers, England.

Fish Noemacheilus barbatulus L. (stone loach) were caught at about four week intervals from single sites in three Derbyshire rivers, with different concentrations of cadmium and lead in sediments and water, during a one year sampling program. Fish were classified by age, site, and sampling occasion. Growth was allometric and affected by temperature. A steady state of cadmium burden was reached by fish of two years or more but not by younger fish. For lead, fish rarely showed an increase in body burden. Differences in body size accounted for most of the variation in cadmium levels between loach of different age groups but were less important for lead levels. The

exponent for body weight was not affected by age of fish and was about 0.79 plus or minus 0.06 for cadmium and 0.13 plus or minus 0.21 for lead. There was some correlation between cadmium levels in fish of different age groups taken at the same time from any site; levels of significance were higher when differences due to body size were discounted. Then, sampling time did not explain a significant part of the residual variation. Fluctuations in the cadmium and lead burdens for fish in the same age group from each of the sites were correlated for some comparisons. Loach from sites with higher metal concentrations had higher levels of both cadmium and lead. It is suggested that cadmium uptake from food contributed considerably to the body burden of loach. (Author's abstract)
W90-00684

CARBOFURAN TRANSFER AND PERSISTENCE IN DRAINED AGRICULTURAL SOILS RELATED TO THEIR STRUCTURE AND ADSORPTION PROPERTIES.
Laboratoire de Protection des Cultures, Nancy (France).
J. Achik, and M. Schiavon.
Ecotoxicology and Environmental Safety EESADV, Vol. 18, No. 1, p 83-92, August 1989. 4 fig, tab 3, 28 ref.

Descriptors: *Pesticides, *Path of pollutants, , *Carbofuran, *Soil properties, *Clays, *Clay loam, *Adsorption, *Leaching, Dissipation.

Carbofuran (Curater 5G) behavior was studied in two drained cornfield soils, clay and loamy-clay, for two successive years. Different dissipations were observed in each soil for the same time period (8 weeks in 1985, 9 weeks in 1986). Drained water from organic matter-rich soil possessed a higher carbofuran content, with 7.1 to 13.7 and 2.5 to 5.0% of the applied dose for clay and loamy-clay soils, respectively. The major part of these percentages arose from the drained waters associated with rainfall occurring during the first 2-3 weeks after application. Laboratory experiments confirmed the influence of the soil structure and its properties on carbofuran adsorption, and consequently on carbofuran leaching under field conditions. (Author's abstract)
W90-00686

HOMOGENEOUS HYDROLYSIS RATE CONSTANTS FOR SELECTED CHLORINATED METHANES, ETHANES, ETHENES, AND PROPANES.
State Univ. of New York Coll. at Cortland. Dept. of Chemistry.
P. M. Jeffers, L. M. Ward, L. M. Woytowitch, and N L. Wolfe.
Environmental Science and Technology ESTHAG, Vol. 23, No. 8, p 965-969, August 1989. 3 fig, 2 tab, 19 ref. Air Force Office of Scientific Research /AFSC, USAF contract F49620-85-C-0013.

Descriptors: *Fate of pollutants, *Chemical degradation, *Hydrolysis, *Chlorinated hydrocarbons, Rate constants.

Hydrolysis rate constants for 18 chlorinated methanes, ethanes, ethenes, and propanes have been measured in dilute aqueous solutions within the temperature range of 0-180 C and at pH values of 3-14. Arrhenius parameters were determined for both neutral and alkaline hydrolysis reactions. Reactivity of these compounds in basic solutions increases in accord with the expected acidity of the most reactive hydrogen atom in the molecule. Neutral hydrolysis appears to depend on both the C-Cl bond strength and the degree of steric hindrance at the reaction site. Only a neutral hydrolysis process occurs for CCl4, 1,1,1-trichloroethane, and 2,2-dichloropropane. The chlorinated ethenes and hexachloroethane react only with hydroxide under severe conditions and exhibit no neutral hydrolysis. Some of these compounds eliminate HCl, whereas others substitute OH for Cl to form alcohols that may react further to give aldehydes or carboxylic acids as products. Environmental hydrolysis half-lives (25 C, pH 7) range from 36 hours for 2,2-dichloropropane to 1850 years for CHCl3 and to over one million years for C2Cl6 and the ethenes. (Author's abstract)
W90-00687

STABLE N-CHLOROALDIMINES AND OTHER PRODUCTS OF THE CHLORINATION OF ISOLEUCINE IN MODEL SOLUTIONS AND IN A WASTEWATER.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5D.
W90-00688

DISSOLVED PETROLEUM RESIDUES AND ALKYLBENZENE PHOTO-OXIDATION PRODUCTS IN THE UPPER ARABIAN GULF.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
M. Ehrhardt, and A. Douabul.
Marine Chemistry MRCHBD, Vol. 26, No. 4, p 363-370, July 1989. 2 fig, 2 tab, 12 ref. Deutsche Forschungsgemeinschaft Grant Eh 39/19-1.

Descriptors: *Oil spills, *Fate of pollutants, *Petroleum products, *Adsorption, *Desorption, Alkylbenzenes, Lipophilic material, Oxidation, Persian Gulf, Ion exchange.

Lipophilic dissolved material was concentrated by in-situ liquid-solid adsorption on Amberlite XAD-2 resin from glass-fiber-filtered coastal seawater in the upper Arabian Gulf in the fall of 1986. Ten percent aqueous acetone was used for countercurrent desorption under reflux. In the concentrated elute petroleum components were characterized and quantified by GC-MS as were ketonic photo-oxidation products of alkylbenzenes. Concentrations of the photo-oxidation products exceeded those of unaltered petroleum components by roughly a factor of ten. (Author's abstract)
W90-00694

IONIC ALKYLLEAD COMPOUNDS IN ENVIRONMENTAL WATER AND SEDIMENTS.
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
D. Chakraborti, R. J. A. vanCleuvenbergen, and F. C. Adams.
Hydrobiologia HYDRB8, Vol. 176/17, p 151-158, July 3, 1989. 2 fig, 3 tab, 18 ref. NFWO Belgium grant 2.0091.85.

Descriptors: *Fate of pollutants, *Path of pollutants, *Water analysis, *Pollutant identification, *Lead, *Degradation, *Chemical analysis, *Organolead compounds, Speciation, Sediments, Extraction efficiency.

To elucidate the occurrence and fate of ionic alkyllead species in environmental water and sediments, a procedure, based on the existing methodology for speciation of lead in the biosphere, has been optimized. It allows species-specific detection of the degradation products of tetra-alkyllead at levels down to 150 pg/L in water or 25 pg/g in sediment. The extraction efficiency from water and sediments was checked by spiking standard solutions of PbMe3(+), PbEt3(+), PbMe2(++) and PbEt2(++) to 9 L amounts of lake water and 50 g amounts of lake sediment. The results indicate an average recovery from lake water of 93% for PbMe3(+) and 85% for PbEt3(+), PbMe2(++) and PbEt2(++). For sediments, the recovery was nearly quantitative for PbMe3(+) and , respectively, 94%, 79% and 55% for PbEt3(+), PbEt2(++), and PbMe2(++). An unexpected observation is the apparent decrease in concentration of the compounds in water and sediments of the lake and, to a lesser extent, in the river during the summer months. This might be the result of a somewhat larger stability of the compounds during the colder and more cloudy winter months. In the lake water, the abundance of the species is in the ranking order PbMe3(+) > PbEt3(+) > PbEt2(++), PbMe2(++). In the river, the order is reversed for the more important compounds. In the lake, the concentration ratio of PbEt3(+) to PbMe3(+) is about 20 times higher in the sediments than in the aqueous phase, whereas the same trend cannot be observed int he estuarine samples. The environmental significance of this observation is unknown. In the stagnant lake water, remobilization of deposited lead is less likely than in the estuary, influenced by tidal effects. In contrast to the lake sediments, PbMe3(+) is the most prominent component in marine sediments, although concentrations fall below the detection limit in samples taken further away from the coast. PbMe2Et(+) is a relatively abundant compound in seawater. (Miller-PTT)
W90-00707

STUDY ON HEAVY METAL PARTITIONING IN SEDIMENTS FROM POYANG LAKE IN CHINA.
Beijing Univ. (China). Dept. of Geography.
J. Chen, L. Dong, and B. Deng.
Hydrobiologia HYDRB8, Vol. 176/17, p 159-170, July 3, 1989. 4 fig, 9 tab, 25 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Lake sediments, *China, Copper, Lead, Zinc, Partitioning, Model studies.

The partitioning of heavy metals in sediment from Poyang Lake, the largest freshwater lake in china, was studied. The majority of the heavy metals (copper, lead and zinc) were found to be bound to the organic matter and iron oxide phases. The distribution of the metals among the different geochemical phases in sediments was controlled by the abundance of the geochemical phases. An equilibrium adsorption model developed by Oakley and Davies-Colley was applied to predict the partitioning of copper among different geochemical phases in the sediments of Poyang lake. The conditional equilibrium constants (slopes of the linear portions of the adsorption isotherms) were determined using an artificial water-sediment system at various pHs. This model was used to describe the heavy metal partitioning in sediment samples from Poyang Lake and the predicted results were consistent with those measured in the laboratory. Calculated results show that the conditional adsorption constants for copper on the iron oxide and humic matter phases are much higher than for kaolinite phase at all pH values selected. The affinity of humic matter and iron oxide for copper is much stronger than kaolinite. These data show that the pH value of the water-sediment systems has a pronounced effect on the conditional adsorption constants. The calculated and measured results for copper associated with the humic matter and iron oxide fractions are similar to each other. A large deviation for the exchangeable phase is probably due to the relatively small amount of copper occurring in this fraction. The relative error of the results predicted by the partitioning model will increase as the sediment composition deviates from that of the sediments used in adsorption experiments. The concentrations of iron oxide and humic material measured in sediments from Poyang Lake ranged from 0.9-2.3% and 0.5-2.8% respectively, with average values of 1.6% and 1.7%. The clay content of soils in this region are reported to about 30%. The copper partitioning among the different secondary phase of Poyang Lake sediments was calculated using the partitioning model. The majority of the copper is predicted to be bound to humic matter and iron oxide phases. (Miller-PTT)
W90-00708

HEAVY METALS IN EELGRASS (ZOSTERA MARINA L.) DURING GROWTH AND DECOMPOSITION.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
J. E. Lyngby, and H. Brix.
Hydrobiologia HYDRB8, Vol. 176/17, p 189-196, July 3, 1989. 6 fig, 1 tab, 26 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Bioaccumulation, *Heavy metals, *Macrophytes, *Eelgrass, Cadmium, Chromium, Lead, Zinc.

The distributions of cadmium, chromium, lead and zinc in eelgrass were studied in samples collected from the field, and the loss/accumulation of the metals during decomposition of eelgrass leaves was

studied in the laboratory. Concentrations of heavy metals in the below grounds parts were greater in the roots than in the different age groups of the rhizomes, whereas highest chromium and zinc concentrations were found in the youngest parts. The concentration of cadmium did not vary. In the above-ground parts, the concentrations of cadmium, lead, and zinc increased with the age of the leaves, and the concentrations in the leaves were greater than in the stem fraction. The concentrations of chromium decreased with age of the leaves. In the laboratory analysis of decomposition of leaf material, the concentrations of chromium, lead and zinc increased significantly and a net absorption from the surrounding water was recorded. Cadmium concentrations were relatively constant and a loss of cadmium was proportional to the release of soluble organic compounds in indicating an association of cadmium with the soluble phase. The utility of compositional analyses and decomposition experiments in assessing the significance of eelgrass in the heavy metal cycling in coastal areas is demonstrated. Furthermore, significant differences in the fate of heavy metals associated with eelgrass detritus are discussed. (Author's abstract)
W90-00710

MERCURY POLLUTION IN TOKUYAMA BAY.
Yamaguchi Univ. (Japan). Dept. of Civil Engineering.
H. Nakanishi, M. Ukita, M. Sekine, and S. Murakami.
Hydrobiologia HYDRB8, Vol. 176/17, p 197-211, July 3, 1989. 8 fig, 8 tab, 21 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Bioaccumulation, *Mercury, *Japan, *Water pollution, *Tokuyama Bay, Effluents, Sediment contamination.

Mercury pollution in Tokuyama Bay is discussed with regard to the following aspects of research and pollution control: (1) the history of mercury pollution, (2) mercury discharge and its accumulation in sediments, (3) behavior of mercury in sediments, (4) mercury contamination of fish, (5) mercury and the health of local residents, and (6) remedial actions. The sediments and aquatic life of Tokuyama Bay (Japan) have been polluted by mercury effluent from chloro-alkali plants. In total, about 380 tons of mercury were released from these plants and 6.64 tons of mercury were discharged into the bay in waste waters between 1952 and 1975, when mercury cells were employed. A number of surveys to study mercury pollution and the effectiveness of control measures in this area were conducted in the early 1970s. Analysis of human hair from Tokuyama Bay residents contained less mercury than those in Minamata and Agano districts where serious mercury poisoning had occurred, but were contaminated with more mercury than those in other unpolluted areas. No occurrence of Minamata disease has been reported in the Tokuyama district. Reclamation of mercury contaminated sediments began in 1975; dredging of the bay continued until 1977. Since then, the levels of mercury contamination in sediments and aquatic life have gradually decreased. Today, there are no problems with respect to mercury pollution. (Author's abstract)
W90-00711

DISTRIBUTION OF NUTRIENTS, TRACE ELEMENTS, PAHS AND RADIONUCLIDES IN SEDIMENT CORES FROM LAKE VARESE (N. ITALY).
Istituto di Ricerca sulle Acque, Brugherio (Italy).
A. Provini, G. Premazzi, S. Galassi, and G. F. Gaggino.
Hydrobiologia HYDRB8, Vol. 176/17, p 213-223, July 3, 1989. 2 fig, 8 tab, 22 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Sediments, *Cores, *Nutrients, *Italy, *Trace elements, *Heavy metals, *Hydrocarbons, Lake Varese, Radioisotopes, Sediment cores.

Sediment cores were collected at 5 stations in Lake Varese. They were analyzed for organic matter, N, P, organic C, Cd, Cr, Cu, Hg, Pb, Zn and PAHs. The use of a sedimentological approach to estimate the risk of some organic compounds has been tested. PAHs were chosen as the test organic contaminants. As in other eutrophic lakes in Northern Italy, this lake is also at considerable risk from heavy metal pollution. Cr, Cu and Cd showed the highest enrichment factors for at least 5 years, 23.4, 8.0, and 7.6, respectively. Other metals had enrichment factors ranging from 1 to 3. Fluoranthene was chosen as a representative PAH, derived from combustion products; its average value in surficial sediments ranged from 100 to 220 ng/l dw. This compound can be a hazard to human health and aquatic life. An evaluation of radionuclide distributions after the recent Chernobyl accident in the USSR (134Cs, 137Cs, 131I, 106Ru) provided useful tracers to follow the cycling of pollutants bound to particulate matter in the aquatic ecosystem. (Author's abstract)
W90-00712

NICKEL SORPTION AND SPECIATION IN A MARINE ENVIRONMENT.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
M. Sadiq.
Hydrobiologia HYDRB8, Vol. 176/17, p 225-232, July 3, 1989. 6 tab, 32 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Marine environment, *Seawater, *Nickel, *Heavy metals, *Sorption, Speciation, Suspended sediments, Hydrogen ion concentration.

Six sediment samples were collected from northern Arabian Gulf. Nickel was added to each sediment-seawater suspension and the concentration of total dissolved Ni in the suspension was monitored for 75 days. The analytical data were used to obtain a linear regression equation relating Ni(++) activity in the sediment suspensions to pH. Using this equation and thermodynamic information, the distribution of Ni species in the suspensions was calculated. The major inorganic species, extrapolated to 35 ppt salinity and pH 8.1, were Ni(++) (60.1%), NiCl(+) (16.9%), NiCl (5.0%), NiOH(+) (0.4%), and NiSO4 (17.5%). An increase in the seawater salinity increased the concentration of total dissolved Ni and Ni chloro-complexes. A decrease in pH of seawater increased total dissolved Ni and decreased NiOH(+) complex, but the portion of other species remained unchanged. There was no significant ($P < 0.05$) effect of Cu, Cd, Pb, Fe, Mn, and Al addition on Ni sorption in the marine sediment suspensions. (Author's abstract)
W90-00713

DETERMINATION OF HEAVY METALS IN WATER, SUSPENDED MATERIALS AND SEDIMENTS FROM LANGAT RIVER, MALAYSIA.
National Univ. of Malaysia, Bangi. Dept. of Nulcear Science.
S. B. Sarmani.
Hydrobiologia HYDRB8, Vol. 176/17, p 233-238, July 3, 1989. 1 fig, 3 tab, 11 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Suspended solids, *Malaysia, *Sediments, Langat River, Neutron activation analysis, Atomic absorption spectrophotometry, Arsenic, Cadmium, Cobalt, Copper, Mercury, Lead, Zinc.

The concentrations and distribution of heavy metals in the Langat River basin (Malaysia) were investigated using instrumental neutron activation analysis for the determination of 12 trace elements in sediments and suspended matter. Atomic absorption spectrometry was used for the analysis of arsenic, cadmium, cobalt, copper, mercury, lead, and zinc in the soluble fraction of the river water samples. The trace elements were not evenly distributed. The concentrations of arsenic, cadmium, cerium, cobalt, scandium, antimony, and zinc were generally highest in the suspended materials, whereas concentrations of chromium, rubidium and torium were always highest in the sediments. Arsenic concentrations in the river were slightly higher than the natural concentration, while the other elements were generally at their natural concentration levels. This suggests that anthropogenic sources of arsenic have entered the river system. The application of arsenical herbicide in the rubber and oil palm plantations within the river basin could be the source of this arsenic pollution. By WHO drinking water standards, the river water is not suitable for drinking without treatment. (Miller-PTT)
W90-00714

TRACE ELEMENTS IN SUSPENDED PARTICULATE MATTER FROM THE YARRA RIVER, AUSTRALIA.
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
P. Sinclair, R. Beckett, and B. T. Hart.
Hydrobiologia HYDRB8, Vol. 176/17, p 239-251, July 3, 1989. 4 fig, 3 tab, 37 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Suspended sediments, *Australia, *Particulate matter, *River flow, Yarra River, Continuous flow centrifugation, Organic matter, Phosphorus, Manganese.

Suspended particulate matter (SPM) was collected from two sites in the Yarra River (Australia) under a range of flow conditions using a continuous flow centrifuge. The SPM from the upstream, largely rural, site at Warrandyte had higher concentrations of organic matter, phosphorus and manganese. SPM collected from the downstream, largely urban, site at Heidelberg had elevated concentrations of lead and zinc. The concentrations of iron, copper and chromium in the SPM changed little between the two sites. Over the study period, the flow-weighted mean concentration of SPM increased 5-fold between the two sites and the load increased 7-fold. The annual load of SPM transported past Heidelberg was estimated to be 1700,000 tonne, with approximately 80% occurring during high flows (> 15 cu m/s). Detailed study of the SPM concentrations during flood events suggests that the northern tributaries to the Yarra are the main contributors of SPM in the region between Warrandyte and Heidelberg. The mean annual load of total phosphorus transported by the Yarra River at Heideleberg was estimated to be 220 tonne, approximately 2.5 times greater than at Warrandyte. Approximately 60% of this load was associated with SPM. The majority (about 80%) of this SPM-bound phosphorus was extractable with 0.1 M NaOH, and is therefore potentially biologically available. There was little difference between the two sites in the flow-weighted mean concentrations of iron, copper, and chromium in SPM. The manganese concentration was approximately halved between Warrandyte and Heiderberg, with most of the loss occurring in the exchangeable and reducible fractions. Lead and zinc concentrations in SPM increased 15 to 16-fold between the two sites, with most of this increase occurring in the exchangeable and reducible fractions. This is some cause for concern, since metals in both these fractions could become available to biota under conditions known to exist in the Yarra estuary. (Author's abstract)
W90-00715

GEOCHEMICAL CHARACTERISTICS OF HEAVY METALS IN THE XIANGJANG RIVER, CHINA.
Academia Sinica, Beijing (China). Inst. of Geography.
Z. Shen, D. Wenjiang, Z. Licheng, and C. Xibao.
Hydrobiologia HYDRB8, Vol. 176/17, p 253-262, July 3, 1989. 4 fig, 5 tab, 8 ref.

Descriptors: *Path of pollutants, *Heavy metals, *China, *Water pollution sources, *Geochemistry, *Sediment contamination, Xiangjang River, Copper, Cadmium, Lead, Zinc.

The results of research undertaken to evaluate the extent of heavy metal pollution of the Xiangjiang River (China) are reported. It is clear that the distribution of heavy metals in the water and sediments of the Xiangjiang River depends directly on the character of the discharged wastes, which de-

termined the concentration of pollutants in river. The speciation of heavy metals in water and sediment samples collected from the river was undertaken in order to provide bioavailability and toxicity information. In water samples collected during November 1984, it was found that the dissolved fraction (< 0.45 microm) contained rather low concentrations of Cu, Cd, Pb and Zn; the exception was the water sample taken from the right side if the river at Zhuzhou. The concentration of heavy metals in the particulate fraction was much higher than in the dissolved fraction for water samples taken from the middle and lower reaches of the river. In the less polluted upstream reaches, the greatest proportion of the heavy metals was generally associated with the dissolved fraction. The concentration of heavy metals Cu, Cd, Pb and Zn in surface water and sediment samples taken from the length of the river revealed significant pollution in the vicinity of two industrial centers (Shuikoushan and Zhuzhou). Additional insight into the potential adverse effects of these elevated concentrations were obtained from studies of the physico-chemical forms (speciation) of these metals in the water column and in sediments. (Miller-PTT)
W90-00716

NUTRIENT REMOBILIZATION PROCESSES AT THE TIBER RIVER MOUTH (ITALY).
Istituto di Ricerca sulle Acque, Rome (Italy).
R. Pagnotta, C. M. Blundo, T. LaNoce, M. Pettine, and A. Puddu.
Hydrobiologia HYDRB8, Vol. 176/17, p 297-306, July 3, 1989. 10 fig, 1 tab, 13 ref.

Descriptors: *Path of pollutants, *River mouth, *Tiber River, *Estuaries, *Saline-freshwater interfaces, *Fate of pollutants, *Italy, *Nutrients, *Eutrophication, Remobilization, Carbon, Phosphorus.

The Tiber River mouth, a typical example of an environmentally stressed estuary in the Mediterranean, is studied in an attempt to elucidate the main factors affecting the distribution of pollutants in its estuarine waters. Results obtained in recent years (1984-1986) on organic carbon and nutrients are reported and are used to provide information on the main processes occurring in the salt wedge region. The behavior of organic carbon and nutrients was investigated during periods of normal summer fluvial flow, in which the final stretch of the river is characterized by a two-layer structure, with the lower saline layer nearly stagnant. Under these conditions, biological remobilization processes appear to be the main factor affecting the behavior of organic carbon, orthophosphate and total inorganic carbon. In particular, the analysis of the stoichiometry of the nutrient regeneration processes, as well as the behavior of dissolved organic carbon and particulate organic carbon as a function of salinity, indicate a significant contribution of anoxic processes to the regeneration of organic matter. These regeneration processes increase the mean concentration of dissolved forms of nutrients in the lower saline layer compared with the theoretical dilution values; in some cases, these concentrations were up to twice as high as the concentrations in the uppper layer. At the end of summer period, the two-layer structure is broken down and the lower stagnant saline water flows to the sea, producing an additional load of nutrients. This source may play an important role in the eutrophic conditions found in late summer, in the coastal region off the Tiber mouth. (Miller-PTT)
W90-00719

USE OF RADIONUCLIDES IN THE STUDY OF CONTAMINANT CYCLING PROCESSES.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
For primary bibliographic entry see Field 5A.
W90-00720

CONCENTRATIONS AND DISTRIBUTION OF FE, ZN AND CU IN TISSUES OF THE WHITE SUCKER (CATOSTOMUS COMMERSONI) IN RELATION TO ELEVATED LEVELS OF METALS AND LOW PH.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W90-00723

ACCUMULATION OF POLY-BETA-HYDROXYBUTYRATE IN A METHANE-ENRICHED, HALOGENATED HYDROCARBON-DEGRADING SOIL COLUMN: IMPLICATIONS FOR MICROBIAL COMMUNITY STRUCTURE AND NUTRITIONAL STATUS.
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Oceanography.
P. D. Nichols, and D.C. White.
Hydrobiologia HYDRB8, Vol. 176/17, p 369-377, July 3, 1989. 1 fig, 2 tab, 32 ref. Department of the Navy contracts N0014-82-C0404 and N0014-83-K0056, NASA contract NAG2-149, and EPA contract CR-813725.

Descriptors: *Path of pollutants, *Fate of pollutants, *Soil contamination, *Soil columns, *Soil bacteria, *Hydrocarbons, *Halogens, *Methane bacteria, Accumulation, Bioassay.

The poly-beta-hydroxybutyrate (PHB) content of soil from a halogenated hydrocarbon-degrading (HHD) column and related controls samples and from methylotrophic bacteria were assayed. The PHB/PLFA (phospholipid ester-linked fatty acid) ratios were determined to yield further insight into the microbial biota and processes involved in the biotransformation of pollutant compounds. The prokarotic, endogenous storage PHB accumulated in soil from a methane-enriched, halogenated hydrocarbon-degrading soil column. Based in phospholipid ester-linked fatty acid (PFLA) profiles, this microcosm has been previously reported to be significantly enhanced in type II methanotrophs. Two strains analyzed of the type II methanotroph Methylobacterium organophilium were found to contain PHB, with PHB/PFLA ratios similar to those determined for the methane-enriched soil column, suggesting that methanotrophic bacteria enriched in the methane-amended column produced PHB. Control soil and sodium azide-inhibited material, in which methanotroph markers were below detection, did not contain PHB. Biochemical assays, based on the differences observed, can be used to monitor shifts in microbial biomass. community structure and nutritional status of systems used to model microbial biotransforamtion processes. Further manipulative experiments with pure methanotrophic bacteria will increase understanding of the mechanism by which PHB is produced. It is shown that biochemical procedures have the potential to monitor the stimulated populations of a native soil microbial community capable of degrading pollutants. Such data may ultimately provide information to assist in the selection and optimization of favorable conditions for the adaption of pollutant biotransformation processes to aquifers. (Author's abstract)
W90-00725

CAN WE DETERMINE THE BIOLOGICAL AVAILABILITY OF SEDIMENT-BOUND TRACE ELEMENTS.
Geological Survey, Menlo Park, CA.
S. N. Luoma.
Hydrobiologia HYDRB8, Vol. 176/17, p 379-396, July 3, 1989. 4 fig, 7 tab, 111 ref.

Descriptors: *Path of pollutants, *Sediment contamination, *Bioavailability, *Trace metals, *Geochemistry, Bioaccumulation, Trace elements.

The limited success achieved in defining the biological availability of metals from sediment is investigated. It is clear from available data that the susceptibility of biological communities to trace element contamination differs among aquatic environments. One important reason is that the bioavailability of metals in sediments appears to be altered by variations in sediment geochemistry. However, methods for explaining or predicting the effect of sediment geochemistry upon metal availability are poor;y developed. Experimental studies demonstrate that ingestion of sediments and uptake from solution may both be important pathways of metal bioaccumulation in deposit/detritus feeding species. Relative importance between the two is geochemistry dependent. Geochemical characteristics of sediments also affect metal concentrations in the tissues of organisms collected from nature, but the specific mechanisms by which these characteristics influence metal bioavailability have not been rigorously demonstrated. Several prerequisites are necessary to better understand the processes that control metal bioavailability from sediments: (1) improved computational or analytical methods for analyzing the distribution of metals among components of the sediments, (2) improved computational methods for assessing the influences of metal form in sediments on sediment-water metal exchange, and (3) a better understanding of the processes controlling bioaccumulation of metals from solution and food by metazoan species directly exposed to the sediments. Such capabilities would allow mechanistic explanations essential to the development of practical tools sought for determining sediment quality criteria for metals. (Author's abstract)
W90-00726

SEDIMENT TOXICITY TESTING IN TWO AREAS OF CONCERN OF THE LAURENTIAN GREAT LAKES: TORONTO (ONTARIO) AND TOLEDO (OHIO) HARBOURS.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
For primary bibliographic entry see Field 5C.
W90-00727

BIOAVAILABLE METAL UPTAKE RATE IN URBAN STORMWATER DETERMINED BY DIALYSIS WITH RECEIVING RESINS.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
G. M. P. Morrison.
Hydrobiologia HYDRB8, Vol. 176/17, p 491-495, July 3, 1989. 2 fig, 1 tab, 12 ref.

Descriptors: *Path of pollutants, *Bioavailability, *Storm water, *Absorption, *Urban drainage, *Heavy metals, Dialysis, Resins.

Bioavailable metal uptake rates are determined in urban stormwater by dialysis with receiving resins. Values at outfalls reflect the sporadic and variable nature of discharges of bioavailable metals with stormwater. The lowest values of Zn, Cu and Pb are found at the site with least traffic. Cadmium, Ni and Cr exhibit similar receiving resins uptake rates at all samples sites. Variations in the uptake rates may be explained in terms of hydrochemical processes affecting bioavailable metal mobilization and transport in the stormwater, including rainfall volume, rainfall acidity and gullypot interstitial water mobilization. Copper uptake rates for Chelex receiving resin as a function of cumulative rainfall over the exposure period is shown. A similar relationship was also found for Cd and Zn. During baseflow (groundwater flow) the uptake rate varies between 0.6 and 4.5 pg/sq mm/h. It is clear that stormwater discharge causes a significant increase of bioavailable Cu uptake rate above the baseflow values. Stormwater values increase up to 82.8 pg/sq mm/h and there appears to be a general increase of values with cumulative rainfall. The acidity of rainfall determines the extent of metal mobilization from urban surfaces and sediments. The lowest continuously monitored stormwater pH value (6.0) over the study period corresponds to the highest Cu uptake rate (82.8 pg/sq mm/h), with a cumulative rainfall of 7.1 mm. As free and weakly complexed dissolved Cu is highly dependent on pH, the high value can be explained in terms of a high Cu availability to the dialysis cell. Evidence of the influence of gullypot and in-pipe sediment processes on metal uptake is provided by a comparison of Pb uptake rate with cumulative rainfall. The in-pipe deposited solids may provide an important source of Pb during baseflow conditions. Interstitial waters provide a rich source of free and weakly complexed metal for early storm washout. (Miller-PTT)
W90-00735

AQUATIC POLLUTION IN THE FAR EAST.
Aquatic Habitat Inst., Richmond, CA.
D. J. H. Phillips, and S. Tanabe.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 297-303, July 1989. 3 fig, 1 tab, 48 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Far East, *Effluents, *Industrial wastewater, Developing countries, Seafood.

An overview of the problems experienced in the Far East relating to aquatic pollution is presented, with an emphasis on the quality of coastal waters. The pollution problems faced by developing and developed nations in the region tend to vary in type according to socioeconomic factors. The appropriate treatment and disposal of sewage remains a particular problem in the developing nations. Industrial and agricultural effluents also exert measurable effects on marine resources in many of these regions. The environmental impacts of major engineering and development projects are also a concern in certain areas. In the developed nations, the impacts of conservative contaminants (especially the highly persistent and toxic organochlorines) are considered to be the most significant problem at present. The region, as a whole, exhibits a great dependence on seafood as a primary or preferred source of protein, and the protection of coastal waters is therefore of vital concern. In addition, tourism provides much-needed foreign exchange in many countries of the region, and the tourist facilities are mostly situated on the coast. Additional regulatory initiatives are required in many areas, coupled to strong legislative action and robust monitoring of coastal pollution, if the vital marine resources are not to be irreversible damaged. (Author's abstract)
W90-00739

POLLUTION OF THE COASTAL WATERS OF HONG KONG.
Hong Kong Univ. Dept. of Zoology.
B. Morton.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 310-318, July 1989. 2 fig, 67 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Hong Kong, *Marine environment, *Coastal waters, *Literature review, Industrial wastewater, Domestic wastes, Farm wastes.

The available literature on Hong Kong's marine coastal pollution is reviewed. The highly urbanized and industrialized cities of Victoria and Kowloon pollute Victoria harbor with untreated domestic sewage and industrial effluents. The development of new cities, Shatin and Tai Po, on the shores of the partially enclosed Tolo harbor have created Hong Kong's first critical marine environmental problem, secondary sewage treatment schemes having been inadequate to prevent this. Agricultural wastes (notable pig manure) compound the problem in Tolo harbor, but virtually everywhere in the New Territories lowland water courses are polluted from this source leading to the degradation of most enclosed bays. Sufficient evidence is at hand to understand local long-term trends in environmental degradation. Hong Kong's coastal waters are polluted generally; Tolo Harbor, grossly so. Concern exists regarding the safety of bathing beach water quality, contaminated sea food, and the overall quality of other enclosed bodies of water in Hong Kong. (Author's abstract)
W90-00740

TRACE METALS AND ORGANOCHLORINES IN THE COASTAL WATERS OF HONG KONG.
Aquatic Habitat Inst., Richmond, CA.
D. J. H. Phillips.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 319-327, July 1989. 5 fig, 2 tab, 47 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Organic compounds, *Coastal waters, *Hong Kong, *Trace metals, *Chlorinated hydrocarbons, Bioindicators, Molluscs.

Available data on trace metals and organochlorines in Hong Kong coastal waters, sediments and biota is reviewed. The coastal waters of Hong Kong receive the sewage discharges from almost 6 million inhabitants, effluents from industry and agricultural wastes. Although generally well-flushed, these waters exhibit significantly elevated concentrations of trace metals and organochlorines in certain areas, on both local and regional scales. The existing pattern of contamination has been well-characterized through both the use of bivalve molluscs as bio-indicators and the analysis of sediments. Some contaminants are of concern with respect to public health; these include cadmium, DDT and metabolites, and isomers of hexachlorocyclohexane. (Author's abstract)
W90-00741

PRESENT STATUS OF THE AQUATIC ENVIRONMENT OF THAILAND.
Chulalongkorn Univ., Bangkok (Thailand). Dept. of Marine Science.
M. Hungspreugs, W. Utoomprurkporn, S. Dharmvanij, and P. Sompongchaiyakul.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 327-332, July 1989. 1 fig, 4 tab, 30 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Thailand, *Aquatic environment, Rivers, Canals, Municipal wastes, Domestic wastes.

The aquatic environment, including major rivers and causes of pollution, of the country of Thailand are discussed. The rapidly increasing population and developing agro-industrial activities in Thailand exert considerable stress on the aquatic environment. Untreated municipal wastes are discharged directly or indirectly to canals and rivers, causing high BOD5 values and bacterial contamination close to populated areas. Improvements in domestic sewage treatment are likely to be prohibitively expensive in the near term at least. Eutrophication of coastal waters is an emerging problem. By contrast, few problems have been documented from trace metals discharged by industries, and the public health threat from seafood contamination does not appear to be significant. Uses of chlorinated hydrocarbon pesticides are declining sharply, these being replaced by hydrocarbon phosphate compounds which degrade rapidly in aquatic environments. Oil pollution has not been a problem, although fears of a major spill exist. Other problems include development of the coastal zone, salinity intrusion, and tin mining. (Author's abstract)
W90-00742

PERSISTENT ORGANOCHLORINES IN JAPANESE COASTAL WATERS: AN INTROSPECTIVE SUMMARY FROM A FAR EAST DEVELOPED NATION.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
S. Tanabe, N. Kannan, M. Fukushimima, T. Okamoto, and T. Wakimoto.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 344-352, July 1989. 6 fig, 3 tab, 63 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution sources, *Chlorinated hydrocarbons, *Coastal waters, *Japan, Developing countries, Pesticides, Polychlorinated biphenyls, Reviews.

The historical, present and likely future impacts of persistent organochlorine contaminants on the health of the coastal waters of Japan are summarized. It is noted that contaminants such as DDT, Hexachlorinated biphenyls (HCH) and polychlorinated biphenyls (PCBs) are generally exhibiting decreased abundances in Japanese coastal waters with time. The present level of contamination of Japanese coastal waters by organochlorine compounds may be best seen from data of the Environment Agency of Japan. It appears that both PCB and the sum of DDT concentrations are higher in biota from western parts of Japan than in organisms from the north of the country; this reflects previous usage patterns. Concentrations of the sum of HCH are rather more uniform, despite their previous use principally in western parts of Japan. New environmental challenges are emerging in Japan, including the contamination of coastal ecosystems by chlordane, particular organophosphate compounds, dioxins, dibenzofurans and coplanar PCBs. Extensive studies are continuing on these contaminants, some of which are of considerable toxicological concern in aquatic environments. (Miller-PTT)
W90-00745

TALITRID AMPHIPODS (CRUSTACEA) AS BIOMONITORS FOR COPPER AND ZINC.
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 5A.
W90-00783

EFFECT OF A SEWAGE PLANT IN THE DISTRIBUTION OF ORGANOCHLORINE RESIDUES IN THE DIYALA RIVER, IRAQ.
Biological Research Center, Baghdad (Iraq).
M. A. Al-Omar, N. H. Al-Ogaily, and D. A. Shebl.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 1-7, March 1989. 1 fig, 4 tab, 8 ref.

Descriptors: *Water pollution sources, *Iraq, *Pesticides, *Halogenated pesticides, *Insecticides, Lindane, Aldrin, Dieldrin, Heptachlor, Chlordane, DDT, Monitoring, Sediments, Diyala River.

Distribution of organochlorine insecticide residues was studied in sediments and water from the lower part of the Diyala River in Iraq, where a large sewage treatment plant is located. Eleven sediment and water samples were collected from each of five stations at about 2 week intervals from March to October 1984. Both sediment and water samples were analyzed by gas chromatography and found to contain different levels of lindane, aldrin, dieldrin, heptachlor, heptachlor epoxide, chlordane and isomers and metabolites of DDT. The highest levels of these compounds were detected in water samples taken in April. No correlations with time of year were observed in sediment samples. The high values in April could be due to the transport of pollutants with the runoff water from highlands upstream. The highest values and most frequent occurrence was for chlordane and DDT in both sediment and water samples. Definite differences between the stations based on the location of the effluent discharge were not found. (White-Reimer-PTT)
W90-00799

TRACE ELEMENT CONCENTRATIONS IN FISH FROM THREE ADIRONDACK LAKES WITH DIFFERENT PH VALUES.
Department of Energy, New York. Environmental Measurements Lab.
M. Heit, C. Schofield, C. T. Driscoll, and S. S. Hodgkiss.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 9-30, March 1989. 9 fig, 43 ref.

Descriptors: *Acid rain effects, *Acidification, *Fish, *New York, *Trace elements, *Heavy metals, *Mercury, *Lead, *Sucker, *Perch, Muscle, Gut analysis, Hydrogen ion concentration, Adirondack lakes.

Concentrations of 29 elements were detected in the axial muscle, and 44 elements were detected in the gut contents of white suckers (Catostomus commersoni) and yellow perch (Perca flavescens) from three lakes located in the New York Adirondack Preserve. The study lakes were acidic Darts Lake, variable pH Lake Rondaxe, and circumneutral Moss Lake. For the majority of the elements, there were no clear differences in the muscle concentrations among fish inhabiting the three types of lakes. Two notable exceptions were Hg and Pb. The highest Hg concentrations were found in fish from the circumneutral lake where the majority of yellow perch exceeded the current FDA action level of 1 microg/g (wet weight) for Hg in foods. Regardless of lake acidity, 90% of the yellow perch had Hg muscle concentrations which exceeded the older FDA action level of 0.5 microg/g (wet weight). The highest Pb concentrations were found, with some exceptions, in the axial muscle of the fish from the acidic lake. Clear trends were not found for the other elements measured. Concentra-

tions of Hg were always much higher in the axial muscle than in the gut contents. Other elements potentially toxic to humans (As, Cd, Ga, Pb, Se, and Tl) were not accumulated in the muscle relative to the gut. In general, the gut contents of both species contained greatly elevated element concentrations relative to the axial muscle, indicating that bioaccumulation of most metals does not occur. (Author's abstract)
W90-00800

DETECTABILITY OF STEP TRENDS IN THE RATE OF ATMOSPHERIC SULPHATE DEPOSITION.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-00801

CADMIUM SOIL SORPTION AT LOW CONCENTRATIONS: VII, EFFECT OF STABLE SOLID WASTE LEACHATE COMPLEXES.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
T. H. Christensen.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 43-56, March 1989. 6 fig, 3 tab, 11 ref.

Descriptors: *Path of pollutants, *Cadmium, *Leachates, *Soil absorption capacity, Landfills, Sludge, Incinerators, Isotherms, Stability, Complexes.

Soil sorption of Cd in solid waste leachates of landfill, sewage sludge, and incinerator residue was studied in the laboratory with emphasis on the behavior of Cd present as stable complexes. A previously developed speciation method was employed to determine free divalent Cd and complexed Cd of various stability. The experiments involved 13 soils covering a wide range of clay contents. Speciation of Cd present in solution after exposure to increasing amounts of soil showed that stable Cd complexes did not sorb onto the soil. This was supported by equilibrium isotherms exhibiting similar solute concentration intercepts and by a leaching study of soil columns which resulted in the same concentration of stable Cd complexes. The stable complexes were of the order of 1 to 10 microg Cd/L. The higher values were found in landfill and sewage sludge leachate. Very little Cd present in the leachates was free divalent Cd (a few percent), which may explain the low Cd distribution coefficients (3 to 70 L/kg) observed in solid waste leachates. Leachates containing a high concentration of stable organic matter may contain significant concentrations of Cd bound to stable complexes to pose a risk to groundwater quality. (Author's abstract)
W90-00802

RADIONUCLIDE LEVELS AT TWO SITES IN A WATER EXTRACTION AREA IN THE NETHERLANDS AFTER CHERNOBYL.
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
A. W. L. Veen, and R. J. De Meijer.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 83-92, March 1989. 3 fig, 5 tab, 10 ref.

Descriptors: *Radioisotopes, *Fallout, *Chernobyl, *The Netherlands, *Nuclear accidents, *Cesium, Cesium radioisotopes, Rainfall, Rhine River, Drinking water, Nuclear tests, Groundwater, Permeability, Adsorption.

The coastal dune aquifer, providing drinking water for a large part of the population of the western Netherlands, is recharged by rainfall and artificial infiltration of Rhine water. Chernobyl fall-out has been detected in both water sources. In the sandy soil at the site of the Provincial Water Supply Company of North-Holland extraction area Chernobyl-derived fallout has added Cs-137 and Cs-134 to the Cs-137 still present after atmospheric nuclear tests in the fifties and sixties. The contribution by Chernobyl fallout to the total radioactivity of the soil is small in comparison to the natural radioactivity largely due to K-40, but it is appreciable in relation to radioactivity remaining from the previous fallout events. Activity concentrations of Cs isotopes in the rainfall-derived water draining from the soil in the lysimeter at a depth of 2.25 m hardly reach the detection limit of 20 to 40 mBq/kg. It may, therefore, be expected that contamination from this source of groundwater, and therefore drinking water, is negligible. The level of radioactive Cs in the bottom mud of the infiltration channels is similar to the level of Cs isotopes in the soil but it is entirely due to the Chernobyl fallout. Permeability rather than adsorptive properties may control the Cs distribution. (Author's abstract)
W90-00804

COMPARISON OF THE EFFECTS OF SEDIMENTS AND STANDARD ELUTRIATES ON PHOSPHORUS KINETICS IN LAKEWATER.
Scarborough Coll., Westhill (Ontario). Life Sciences Div.
For primary bibliographic entry see Field 5C.
W90-00805

COPPER TOXICITY AND CHEMISTRY IN THE ENVIRONMENT: A REVIEW.
Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5C.
W90-00806

SPATIAL AND TEMPORAL VARIATION OF HEAVY METALS IN SEDIMENT CORES FROM THE CALCASIEU RIVER/LAKE COMPLEX.
McNeese State Univ., Lake Charles, LA. Dept. of Chemistry.
C. S. Mueller, G. J. Ramelow, and J. N. Beck.
Water, Air and Soil Pollution WAPLAC, Vol. 43, No. 3/4, p 213-230, February 1989. 12 fig, 3 tab, 15 ref. DOE Grant No. DE-FG01-83EP31111.

Descriptors: *Water pollution sources, *Heavy metals, *Sediments, *Louisiana, *Calcasieu River, *Calcasieu Lake, Lake Charles, Spatial distribution, Temporal distribution, Copper, Zinc, Chromium, Lead.

Sediment cores were obtained from several locations in the Calcasieu River/Lake Complex (Louisiana), including Calcasieu Lake, Calcasieu River, two bayou tributaries, and Lake Charles, during the period from November 1983 to November 1985. The cores were analyzed for Cu, Zn, Cr, and Pb. The approximate sedimentation rate and a core chronology were determined by the use of Cs137 and Pb210. The increase in metal concentrations after 1933, particularly along Bayou d'Inde where most industries are located, points to anthropogenic input of these metals to the system. The fact that metal concentrations tend to merge to a common value prior to 1940 throughout the system suggests that geological factors do not contribute to the observed variations in metal concentrations of heavy metals found in this area. The background concentrations of heavy metals found in this study for the Calcasieu River/Lake Complex were: Cu (10 mg/kg), Cr (25 mg/kg), Pb (8 mg/kg), and Zn (40 mg/kg). The main emphasis of the study focused along Bayou d'Inde due to the enhanced levels of heavy metals found. (Author's abstract)
W90-00808

GEOCHEMICAL STUDIES IN A REMOTE SCOTTISH UPLAND CATCHMENT II. STREAMWATER CHEMISTRY DURING SNOW-MELT.
University of East Anglia, Norwich (England). School of Environmental Sciences.
P. W. Abrahams, M. Tranter, T. D. Davies, and I. L. Blackwood.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 231-248, February 1989. 4 fig, 5 tab, 43 ref.

Descriptors: *Acid rain, *Acidification, *Scotland, *Acid streams, *Path of poilutants, *Snowmelt, *Heavy metals, *Stream discharge, Streams, Catchment areas, Aluminum, Cadmium, Copper, Magnesium, Sodium, Chlorides, Nitrates, Sulfates, Lead, Manganese, Calcium, Hydrogen ion concentration.

'Acid-flush' events, monitored in an upland catchment in the Cairngorm Mountains (Scotland) at the time of the spring-thaw, are associated with an increase in stream discharge and raised concentrations of both major ions Ca, Mg, Na, Cl, NO3, and SO4) and trace-elements (Al, Cd, Cu, Fe, Mn, and Pb), in addition to H+. The stream water chemistry is determined by the hydrological pathways which are operative in the catchment during these periods of snowmelt, and reflects both the meltwater composition and the influence of the soils within the catchment. Aluminum, in particular, is leached from the soils and high concentrations (up to 330 micrograms/L) occur in the streamwaters. The presence of frozen soils, which result largely due to the influence of meteorological conditions prior to the accumulation of the snowpack, is likely to have a large impact on the Al concentrations in the streamwaters. The low concentrations of Ca monitored in the stream during the periods of snow-melt (<0.2 mg/L) may promote subsequent toxic effects of the Al to aquatic life forms. (Author's abstract)
W90-00809

ACIDIFYING POTENTIAL OF ATMOSPHERIC DEPOSITION IN CANADA.
Atmospheric Environment Service, Downsview (Ontario).
T. G. Brydges, and P. W. Summers.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 249-263, February 1989. 5 fig, 2 tab, 27 ref.

Descriptors: *Pollutant identification, *Acid rain, *Canada, *Hydrogen ion concentration, Sulfates, Nitrates.

It is proposed that the value of the residual hydrogen ion concentration, ((H+) = (SO4--)-(Ca++ + Mg++)) in precipitation is a suitable way to describe the acidifying potential (AP) of the wet deposition. In eastern North America, the AP of precipitation varies from 20 to 85% of the total sulfate, the remainder of the sulfate being neutralized H2SO4, sulfate from salts in dust or from sea salt. The AP ranges from 20 to 80% of the H+ in the wet deposition. The rest of the H+ is contributed by the net effect of N compounds. Ammonium and nitrate ions from ammonia and NOx emissions do not represent a net acidic loading to the terrestrial ecosystem if they are taken up by vegetation. However, when N leaches from watersheds in the form nitrate, it constitutes an acidifying demand on the ecosystem. Therefore, the overall net acidifying potential (NAP) applied to the terrestrial ecosystem is defined by the value of ((SO4--)-(Ca++ + Mg++)) in precipitation plus (NO3-) in runoff from the watershed. (Author's abstract)
W90-00810

COPPER AND ZINC BALANCE IN SOILS, RICE PLANTS AND AQUATIC SYSTEMS IN AN AREA ALONG THE FUCHU PRECIPICE LINE, TOKYO, JAPAN.
Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 4C.
W90-00811

CHEMICAL COMPOSITION OF RAINFALL IN A CITY OF NORTHERN SPAIN.
Cantabria Univ., Santander (Spain). Dept. of Medical Physics.
N. Diaz-Caneja, A. Bonet, I. Gutierrez, A. Martinez, and E. Villar.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 277-291, February 1989. 2 fig, 4 tab, 38 ref.

Descriptors: *Air pollution sources, *Water pollution sources, *Acid rain, *Spain, *Path of pollutants, Sulfur compounds, Regression analysis, Santander.

A study was carried out over a period of 4 yr on precipitation in Santander, a coastal city with heavy rainfall in the north of Spain. An increase in

acidity was found for the latter period studied, from April 1984 to April 1985, possibly due to a change in the meteorology of the area in this period. The correlations between the ions themselves, and with pollution from SO2 and suspended particulate matter, as well as possible correlations with meteorological variables were analyzed using a multiple linear regression method. The influence of mid-range and long-range transport of pollutants was also analyzed and found to be important when air masses come from highly industrialized zones both in Central Europe and in neighboring Spanish regions, although the contribution of the latter to total acid deposition is less owing to low frequency and the usually low volume of precipitation. (Author's abstract)
W90-00812

CADMIUM ACCUMULATION IN FIDDLER CRABS UCA ANNULIPES LATRELLE AND UCA TRIANGULARIS (MILNE EDWARDS).
Andhra Univ., Waltair (India). Dept. of Zoology.
V. U. Devi, and Y. P. Rao.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 309-321, February 1989, 6 fig, 6 tab, 32 ref.

Descriptors: *Cadmium, *Path of pollutants, *Crabs, *Bioaccumulation, *Water pollution sources, *Toxic wastes, Heavy metals, India.

Tissue specific accumulation of Cd was investigated in relation to exposure period and concentration in Uca annulipes and Uca triangularis obtained from polluted (Visakhapatnam harbor) and unpolluted (Bhimilipatnam) areas. Both the species of the crabs from polluted area were found to accumulate more Cd in their tissues when compared to those of unpolluted area. Of all the three tissues (gills, hepatopancreas, muscle of chela) studied, major accumulation of Cd was observed in hepatopancreas. In gills, Cd accumulation was concentration dependent whereas in hepatopancreas, it was time dependent. U. triangularis of Bhimilipatnam was found to be sensitive showing relatively high value of Fractional Retention Coefficient. (Author's abstract)
W90-00814

BEHAVIOR OF CD, PB, AND CU IN THE MARINE DELTAIC AREA OF THE PO RIVER (NORTH ADRIATIC SEA).
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
G. M. Ferrari, and P. Ferrario.
Water, Air and Soil Pollution WAPLAC, Vol. 43, No. 3/4, p 323-343, 10 fig, 4 tab, 24 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Deltas, *Po River, *Adriatic Sea, Estuaries, Cadmium, Lead, Copper, Sediment-carrying capacity.

An analysis of the spatial trend of concentrations and of the correlation between heavy metals and total suspended matter was performed in a multidisciplinary study of transport of pollutants in the marine coastal area involving in situ investigations, remote sensing techniques and modeling. This paper presents results concerning the chemical behavior of heavy metals (Cu, Cd, Pb) in the North Adriatic Sea and in particular in the marine deltaic area of the Po river. The samples were collected during the JRC Remote Sensing Campaigns ADRIA 84 and ADRIA 85, carried out in the entire North Adriatic Sea and in the selected area in front of the Po when passing from the fluvial to the marine environment. In the dissolved phase, Cu undergoes a dilution process consistent with the mixing theory, while there is a tenfold increase in Pb concentrations. A pronounced tendency to augment the level in the dissolved phase is observed for all three elements in the pelagic waters. In the particulate phase, Cd and Cu, after a diminution in the nearshore stations, their concentration increases as a pelagic area is approached. The total amount of heavy metals in solid phase of the water decreases according to the dispersion and the sedimentation processes of the fluvial load in the marine water. A satisfactory correlation was found between the Cu and Pb with the total suspended matter (TSS). An attempt was made to characterize sediments and suspended matter in order to assess the role of the organic and mineralogical components on heavy metal behavior. (Author's abstract)
W90-00815

USE OF STRONTIUM-90 IN FISH VERTEBRAE AS AN EFFLUENT EXPOSURE TRACER IN PCB-CONTAMINATED CHANNEL CATFISH.
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth.
Water, Air and Soil Pollution WAPLAC, Vol. 43, No. 3/4, p 375-386, February 1989. 2 fig, 1 tab, 16 ref. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Path of pollutants, *Tracers, *Strontium radioisotopes, *Catfish, *Polychlorinated biphenyls, *Bioaccumulation, *Radioactive tracers, Fish migration.

Strontium-90 was measured in the vertebrae of channel catfish (Ictalurus punctatus) collected from an embayment and the adjoining river/reservoir in order to determine their exposure to the polychlorinated biphenyl (PCB) and (90)Sr-contaminated effluent entering the embayment from a point-source discharge. Concentrations of PCBs in the fish were measured and compared with the (90)Sr levels to assess the role of the effluent as a possible source of PCB contamination in catfish in the river and embayment. Catfish exposed to the elevated levels of (90)Sr in the embayment were found to migrate into uncontaminated areas of the river where they were available to anglers. The pattern of PCB contamination in catfish did not mirror that of (90)Sr; hence, little of the PCB burden of the fish in the river could be traced to continuing PCB discharges to the embayment. (Author's abstract)
W90-00817

TRACE INORGANIC SPECIES IN PRECIPITATION AND THEIR POTENTIAL USE IN SOURCE APPORTIONMENT STUDIES.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch, and G. T. Wolff.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 401-412, February 1989. 2 fig, 3 tab, 23 ref.

Descriptors: *Acid rain, *Tracers, *Trace elements, *Path of pollutants, Heavy metals, Inorganic acids, Sulfates, Nitrates, Calcium, Titanium, Iron.

Trace species in atmospheric particles have frequently been used to apportion pollutants in acid rain to their sources by comparing the relative concentrations of trace species at the source and receptor sites. Another approach is to use the trace species in precipitation directly in a source apportionment. This has rarely been done due to the paucity of data on trace species in precipitation and the unknown fractionation of the species during the scavenging process. A study was undertaken to analyze precipitation for a large number of trace species and to compare the concentrations with those in atmospheric particles. Precipitation was collected in Lenox, MA during the summer of 1984. Extreme measures were taken to avoid contamination during collection and analysis. Using five analytical methods, including the novel method of freeze-drying the precipitation followed by neutron-activation analysis, 31 species were analyzed in the rain. The trace concentrations measured in this study were lower than those found in earlier studies, where contamination was believed to be a problem. Concentrations of trace species in the precipitation were compared with those in atmospheric particles. A few species were enriched in precipitation relative to particles, including some large-particle species (Ca, Ti, Fe) and species with gaseous precursors (SO4, NO3, Br). Due to this enrichment, these species should be carefully considered before using them in source apportionment calculations. However, most species showed similar enrichments in precipitation and in atmospheric particles, suggesting that negligible fractionation had taken place during the scavenging process. These species could be used effectively in the future to apportion the pollutants in precipitation to their various sources. (Author's abstract)
W90-00818

EFFECT OF BACTERIA AND BIOTURBATION BY CLYMENELLA TORQUATA ON OIL REMOVAL FROM SEDIMENT.
Connecticut Univ., Noank. Marine Research Lab.
C. Koerting-Walker, and J. D. Buck.
Water, Air and Soil Pollution WAPLAC,Vol 43, No. 3/4, p 413-424, February 1989. 5 fig, 1 tab, 38 ref.

Descriptors: *Biodegradation, *Polychaetes, *Microbial degradation, *Oil pollution, *Fate of pollutants, Marine sediments, Clymenella.

Clymenella torquata, a representative of conveyor-belt feeding tube worms, was studied in laboratory microcosms for its effect on the removal of No. 2 fuel oil from sediment. Possible enhancement of microbial degradation of the oil was considered as well. Concentrations of the aromatic fraction of the oil were measured by synchronous fluorescence spectroscopy. Clymenella reduced the oil concentration of the surrounding sediment by 20 to 50% ($p < 0.05$) in 10 days. Concentrations of oil in the worm tubes were 25 to 32% ($p < 0.001$) less than the surrounding sediment. Sediment bacteria cultured in oil supplemented artificial sea water could use the oil as their sole C source, but did not significantly degrade the aromatic fraction. (Author's abstract)
W90-00819

PHOSPHORUS EXCHANGE KINETICS AND EXCHANGEABLE PHOSPHORUS FORMS IN SEDIMENTS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
H. Furumai, T. Kondo, and S. Ohgaki.
Water Research WATRAG, Vol. 23, No. 6, p 685-691, June 1989. 8 fig, 4 tab, 20 ref.

Descriptors: *Limnology, *Nutrients, *Path of pollutants, *Fate of pollutants, *Eutrophication, *Cycling nutrients, *Lake sediments, *Phosphorus, *Sorption, Radioactivity techniques, Hydrogen ion concentration, Japan.

Exchange kinetics of phosphorus between sediments and water was studied using radioisotope 32P inorganic phosphates. The sediments were collected at Lake Kasumigaura, Japan. After adsorption-desorption equilibrium was attained in the sediments-water batch system, the radioisotope was added and the radioactivity was measured with time. The adsorption-desorption reaction was composed of an exchange reaction and a slow reaction. The exchange reaction has two phases-a very rapid reaction and a Langmuir type reaction. The very rapid exchange rates were calculated by measuring decreases in 32P activity during 0.5 min at different pH values. The adsorption rate constants of the very rapid exchange ranged from 24.3 to 63.8 (/h). The values were much higher than those of the Langmuir type exchange after 0.5 min. The forms of exchangeable phosphorus in sediments were investigated by a phosphorus fractionation method. More than 80% of the exchangeable phosphorus in sediments appeared in NH4F-P(Al-P) and NaOH-o-P(Fe-P) fractions at pH7. Adsorbed phosphorus by addition of phosphate was recovered in the above mentioned phosphorus forms. Most of the recovered phosphorus was exchangeable with dissolved phosphate in solution after 24 h of adsorption. However there was a difference in relative exchangeability between phosphorus in these fractions. The NH4F-P has a higher relative exchangeability than NaOH-o-P and part of adsorbed phosphorus as NaOP-o-P was converted from exchangeable-P into inactive-P. (Author's abstract)
W90-00823

INORGANIC AND METHYL MERCURY IN INLAND WATERS.

Cagliari Univ. (Italy). Ist. di Igiene e Medicina Preventiva.
M. Schintu, T. Kauri, and A. Kudo.
Water Research WATRAG, Vol 23, No. 6, p 699-704, June 1989. 2 tab, 26 ref.

Descriptors: *Path of pollutants, *Mercury, *Methylmercury, *Rivers, *Lakes, *Canada, Laboratory methods, Detection limits.

The proportion of methylmercury to the amount of total mercury has been determined in river and lake water samples from the Ottawa Valley in Canada. The results showed that a relatively constant equilibrium between organic and inorganic mercury has been maintained over the last decade in the Ottawa area. A simple method to determine both organic and inorganic mercury in natural waters is described. After the extraction with dithizone-chloroform, inorganic mercury was back extracted to aqueous solution with sodium nitrite, while methylmercury was recovered to the aqueous medium with sodium thiosulfate. Mercury was determined by a two-stage gold amalgamation technique in conjunction with cold vapour atomic absorption spectrometry. Preconcentrating the mercury from 2l. samples, the method provided a detection limit of 0.lng/L. (Author's abstract)
W90-00825

COMPARATIVE STUDY OF WATER MINERALIZATION AND NUTRIENT STATUS IN THE MAIN WATER COURSES OF BISCAY (BASQUE COUNTRY).
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
E. Orive, A. Basaguren, B. G. deBikuna, and M. Cacho.
Water Research WATRAG, Vol 23, No. 6, p 705-710, June 1989. 6 fig, 1 tab, 21 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Eutrophication, *Spain, *Mineralization, *Nutrients, *Rivers, *Stream pollution, Chlorides, Sodium, Sulfates, Calcium, Saline water intrusion, Comparison studies, Principal component analysis, Spain.

Seventeen physico-chemical variables related to water mineralization and nutrient status were analyzed at 175 sites of the principal catchment areas of Biscay (Basque Country, North Spain). Each site was visited on four occasions: winter, spring, summer and autumn and all data were ordered by means of principal component analysis. The chemical features of the less polluted waters differ markedly from those located in the westward part, with low mineral content, and those that are moderately mineralized. Rivers differ also in their buffering capacity and this is specially evident in polluted rivers. Differences between sites are specially marked in polluted rivers and in natural rivers poorly mineralized. Seasonal differences are also smaller in less perturbed sites. The River Nervion is significantly richer in chloride, sodium, sulfate and calcium than all other sites as a result of the typology of the substratum of its catchment area, dominated by calcareous beds with salt intrusions at the upper reaches. (Author's abstract)
W90-00826

OCCURRENCE AND SPECIATION OF BERYLLIUM IN ACIDIFIED FRESHWATERS.
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
J. Vesely, P. Benes, and K. Sevcik.
Water Research WATRAG, Vol. 23, No. 6, p 711-717, June 1989. 4 fig, 4 tab, 31 ref.

Descriptors: *Acidification, *Acid rain effects, *Water pollution sources, *Beryllium, *Acidic water, *Chemical speciation, Aluminum, Iron, Trace elements, Hydrogen ion concentration.

Surface waters of acidified areas not only exhibit increased concentrations of aluminum, but also an increase in the concentration of iron (at pH<4.4) and of some trace elements. The concentration of highly toxic beryllium exponentially increases with pH decreasing from 7 to 4. The mean molar concentrations of Be in Czech surface waters were higher than 100 nM (c. 1 micrograms/L) at pH-4.0; they exceeded the concentrations of other non-biogenic trace elements (Cd, Pb, As) ten times at a similar pH and were about 100 times higher than the Be concentrations in weakly alkaline waters. A study of the Be speciation employing dialysis in situ, filtering and calculations suggests that an increase in the Be mobility is supported by the formation of the BeF+ fluorocomplex and complexes with fulvic acids but, on the other hand, is suppressed by adsorption on natural solids and by a lack of free fluoride ions. Beryllium enters acid waters and soil solutions together with aluminum during dissolution of its compounds and by desorption from oxohydroxides of iron, formed at higher pH values. (Author's abstract)
W90-00827

ADSORPTION AND RELEASE OF PHOSPHATE FROM SEDIMENTS OF A RIVER RECEIVING SEWAGE EFFLUENT.
Southern Water Authority, Chatham (England). Kent Div.
I. Fox, M. A. Malati, and R. Perry.
Water Research WATRAG, Vol 23, No. 6, p 725-732, June 1989. 4 fig, 6 tab, 47 ref. Department of the Environment Contract No. PECD 7/7/039.

Descriptors: *Path of pollutants, *Water pollution sources, *Water pollution effects, *Cycling nutrients, *Phosphates, *River sediments, Adsorption, Wastewater outfall, Effluents.

Data are reported which are relevant to the possible effects of river sediments on the concentration of phosphate in its water. This is significant for the Kentish River Stour in view of discrepancies in the mass balance of phosphorus, P, downstream from Ashford Sewage Treatment Works, STW. Sediment samples were collected from the sites at Longport Bridge, LB, Godmersham Park, GP, and Shalmsford Street, SS, which are located 1, 10 and 16 km, respectively, from STW. Characterization of the samples by chemical analysis showed that the percentage Fe and Fe-bound P decreased with increasing distance from STW whereas the percentage Ca and saloid-P increased. X-ray diffraction showed that phlogopite, a mica mineral, was the main constituent whilst calcite was apparent in the SS sediment. Phosphate adsorption or desorption kinetics exhibited an initial rapid stage followed by a slower process, whose data fitted a reversible second-order equation. The forward rate constants, kl, were between 1 and 2 cu dm/mol/min and were dependent on pH, calcium and nitrate ion concentrations. Adsorption rates under nitrogen at pH 8.0 and 25 degree C increased in the order: LB<GP<SS whereas the order was GP<LB<SS for adsorption in air. For the LB deposit, the marked depression of kl on excluding air by nitrogen was related to its high Fe content. Rates of native phosphate release increased with increased distance from STW and on replacing air by nitrogen especially for the SS deposit. The results suggest that the bonding of P is weaker in calcareous compared to iron-containing sediments. On the basis of the results obtained some phosphate strategies are discussed as well as the relevance of the data to other watercourses. (Author's abstract)
W90-00829

CONCENTRATIONS AND FATE OF LINEAR ALKYLBENZENE SULPHONATE IN SLUDGE AMENDED SOILS.
Soap and Detergent Industry Association, Hayes (England).
M. S. Holt, E. Matthijs, and J. Waters.
Water Research WATRAG, Vol 23, No. 6, p 749-759, June 1989. 4 fig, 19 tab, 19 ref.

Descriptors: *Fate of pollutants, *Linear alkyl sulfonates, *Sludge utilization, *Soil amendments, Detergents, Soil analysis, Plant growth, England.

The concentration of LAS (linear alkylbenzene sulfonates) in soils are given for a large number of locations (24 farms and 51 fields) in the Thames Water Authority (TWA), U.K. The sites selected provide a range of soil types, frequency and concentration of sludge applications and agricultural uses (pasture/arable). In addition, the disappearance of LAS from soil with time is shown at three selected sites following different sludge application practices. A solid phase extraction-HPLC method, employing a Soxhlet extraction technique to recover LAS from soil matrices is described for these determinations which gave an average recovery of LAS (2-15 micrograms/G spikes) of 97%. In fields (42) not recently spread with sludge (prior to 1987) the concentrations of LAS found in the sludge amended soil are generally less than 1 microgram LAS/G soil. When this data is compared with the estimated total cumulative load based on known sludge applications the majority of the sites show losses of LAS>98%. In fields (9) recently spread (during 1987) the concentrations of LAS in soil are in the range <0.2-20 micrograms/G representing losses of LAS between 70 and 99% of the estimated total cumulative load. The time course studies confirm the rapid removal of LAS from sludge amended soils at three locations (5 fields) and for three different methods of application. The calculated half-lives for LAS in soil range from 7 to 22 days and agree with laboratory test results and other monitoring studies. The homologue distributions determined for LAS in soil suggest that microbial breakdown rather than leaching is the prime mechanism for its removal. Overall, the data indicate that an adequate safety margin exists between the concentrations of LAS in sludge amended soils and those likely to affect the growth of crop plants. (Author's abstract)
W90-00833

FRACTIONATION OF PARTICULATE MATTER, THE TRACE METALS CU, CD, AND ZN, AND LIPIDS IN FOAM AND WATER BELOW NIAGARA FALLS.
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W90-00838

LEAD AND CADMIUM LOADINGS TO THE GREAT LAKES FROM PRECIPITATION.
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
D. F. Gatz, V. C. Bowersox, and J. Su.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 246-264, 1989. 8 fig, 3 tab, 34 ref. USEPA, Great Lakes National Program Office, Chicago, Grant No. R005882-01, U.S. Department of Energy Grant No. DE-FG02-88ER60635.

Descriptors: *Heavy metals, *Cadmium, *Lead, *Metals, *Water pollution sources, *Great Lakes, *Chemistry of precipitation, Bulk collectors, Samplers, Error analysis.

We present the first analysis of precipitation chemistry data from the Great Lakes Atmospheric Deposition (GLAD) network of wet-only precipitation samplers. Lake loadings were calculated from 1-yr or 2-yr (1982-1983) volume-weighted mean ion concentrations and 30-yr mean annual precipitation amounts, using an objective analysis method to interpolate measurements to a 40 x 40 km square grid over the Great Lakes region. The results show that atmospheric loadings of Cd, Pb, and other cations to the Great Lakes are in many cases considerably smaller than those estimated from the bulk precipitation measurements of the early 1970s. For Pb, some portion of the differences can be accounted for by the decrease in emissions that resulted from reductions in the Pb content of gasoline. Valid dry deposition in the bulk samplers also accounts for a portion of the differences. However, for the most extreme differences, contamination of the bulk collectors by resuspended local surface dust is likely to be a major cause. Good agreement was noted between the precipitation-only loadings derived from the GLAD data and those recently given by other authors. (Author's abstract)
W90-00844

TEMPORAL AND SPATIAL VARIABILITY IN SEDIMENT AND PHOSPHORUS LOADS TO LAKE SIMCOE, ONTARIO.
Department of Fisheries and Oceans, Burlington

(Ontario).
M. G. Johnson, and K. H. Nicholls.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 265-282, 1989. 6 fig, 5 tab, 18 ref.

Descriptors: *Ontario, *Phosphorus, *Sedimentation rates, *Pollution load, *Water pollution sources, *Lake Simcoe, Sonar, Sediment load, History, Fish populations, Nonpoint pollution sources, Anthropogenic effects, Point-source pollution.

Information on sediment and phosphorus loads through time and space, coupled with descriptions of trends in water quality and fish communities, provide useful reference points and goals for water management. These are needed in Lake Simcoe where the coldwater fish community and water quality have deteriorated. The sedimentation basin and thickness of post-glacial beds in Lake Simcoe were defined by sonar and, together with data on total phosphorus (P) and bulk density, used to estimate the pre-1800 sediment load of 27,300 t/yr and P load of 28.2 t/yr. The recent sediment load of 63,900 t/yr and P load of 74.6 t/yr were obtained by scaling up pre-1800 rates using ratios of recent to pre-1800 mass sedimentation rates and P loads at 20 core stations. Time-variable mass sedimentation rates and P-concentration profiles facilitated the division of P load into three components--natural load, anthropogenic non-point-source load and anthropogenic point-source load. Analysis of temporal trends indicated that non-point-source P inputs peaked approximately 85-95 yr before present (BP), declined to about 30 yr BP, and increased again since then in the main basin. The dominant peak in Cook Bay occurred 35-45 yr BP after marshes at the head of the bay were drained and the lower Holland River was channelized for agricultural purposes. Point-source P was detected in cores beginning about 50-75 yr BP and increased toward the sediment-water interface. Spatial distribution of P load changed after settlement when altered limnological conditions and loss of marshes changed the P-retention coefficients (R) in bays. (Author's abstract)
W90-00845

MODELING THE LONG-TERM BEHAVIOR OF AN ORGANIC CONTAMINANT IN A LARGE LAKE: APPLICATION TO PCBS IN LAKE ONTARIO.
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 283-297, 1989. 9 fig. 6 tab., 12 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Lakes, *Polychlorinated biphenyls, *Lake Ontario, *Model studies, Water pollution, Loadings, Air, Aerosols, Sediments, Aquatic life, Bioindicators, Response time, Contaminant dynamics.

A model, based on the fugacity concept, is described and illustrated by application to the time varying fate of a contaminant (PCBs) in Lake Ontario over the period 1940-2000. Expressions are included for loadings and partitioning of the contaminant between the phases of air, aerosols, water, suspended and bottom sediments, various trophic levels of aquatic organisms, and gull eggs. Also included are expressions for transformation rates, and transport rates for diffusion between water and sediment, and water and air, wet and dry atmospheric deposition, sediment deposition, burial and resuspension, and water and suspended matter inflow and outflow. The results obtained by numerical integration and by assuming reasonable loading and air concentrations are in accord with reported data. It is shown that PCBs cycle appreciably between atmosphere and water by wet and dry deposition and volatilization, and between water and sediment by deposition, resuspension, and diffusion. Biomonitors are shown to be particularly valuable indicators of contamination levels in the ecosystem. The model is used to explore the response time of the system to loading changes, showing that water column response time is much shorter than the hydraulic residence time. Comparison is also made with a simpler steady state version which can be solved algebraically. It is a tool that can contribute to a better quantitative understanding of contaminant dynamics in large lakes and thus to the remediation of contaminated ecosystems. (Author's abstract)
W90-00846

ATMOSPHERIC DEPOSITION OF CHEMICAL CONTAMINANTS TO THE GREAT LAKES.
Rhode Island Univ., Narragansett. Center for Atmospheric Chemistry Studies.
R. Arimoto.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 339-356, 1989. 1 fig, 7 tab, 83 ref.

Descriptors: *Great Lakes, *Chemistry of precipitation, *Water pollution sources, *Pollutant identification, *Air pollution, Toxic substances, Trace elements, Transfer processes, Organic compounds, Volatilization.

The contamination of air and water by persistent toxic substances is one of the most important environmental issues confronting the Great lakes region. The atmospheric transport and deposition of chemical contaminants is a dominant source for many of these chemicals, but accurate estimates of the fluxes have been elusive. Data for the concentrations of trace substances in the various environmental compartments are scant, and several of the important transfer processes are not fully understood. Continued laboratory and field studies are required to understand the mechanisms responsible for the fluxes of trace substances between the atmosphere and the lakes including the volatilization of organic compounds from lake surfaces and the role of waves and bubbles on gas exchange. Techniques for measuring the dry deposition of particles to large natural water surfaces need to be developed, and microlayers need to be characterized to assess their biogeochemical significance. (Author's abstract)
W90-00851

PARTITIONING OF ZINC BETWEEN THE WATER COLUMN AND THE OXIC SEDIMENTS IN LAKES.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
A. Tessier, R. Carignan, B. Dubreuil, and F. Rapin.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 7, p 1511-1522, July 1989. 7 fig, 2 tab, 56 ref.

Descriptors: *Water chemistry, *Zinc, *Lake sediments, *Lakes, *Sediment-water interfaces, *Path of pollutants, *Sorption, Acidic water, Hydrogen ion concentration, Trace metals, Adsorption, Geochemistry.

Zinc (Zn) concentrations were measured in oxic sediments and in the associated interstitial and overlying waters at 40 littoral stations of various lakes representing a large pH range (pH 4-8.4) and variety of zinc concentrations. Large concentration gradients of dissolved Zn were found at the sediment-water interface of acid lakes (pH < 6). Concentrations of dissolved Zn in the overlying waters were found to be highly undersaturated with respect to Zn(OH)2 and ZnCO3 and in general with respect to ZnSiO3, ruling out solubility equilibrium with pure solid phases as a mechanism of control of Zn concentrations in the overlying waters. The partitioning of Zn between the overlying water and the surficial sediments was described by sorption processes, using either the distribution coefficient model or a simplified version of the surface complexation model. In the latter model, binding intensity values, KA, for the sorption of Zn to natural iron oxyhydroxides have been estimated using the field data of the partitioning of Zn in oxic lake sediments and their dissolved concentrations in the associated overlying waters. The following empirical relationship between KA and lake pH was found: log KA = 1.21 pH-2.83 (r(squared) = 0.89). The pH dependence of KA is in agreement with recent theory on the adsorption of trace metals at oxyhydroxide surfaces, but the binding intensity values derived from field measurements differ markedly in some cases from those of the equilibrium constants obtained for Zn in laboratory experiments. As several observations suggest that Fe-bound Zn is mobile, the distribution of labile Zn between the water column and the sedimentary iron oxyhydroxides has been calculated as a function of pH for typical shallow lakes with the log KA-pH empirical relationship. This model predicts that most of the mobile Zn should be present in the water column at pH < 5 and in the surficial sediments above pH 7. The pH interval 5.5-6.5 defines a region where changing pH in the water column should have the most pronounced effect on the partitioning of Zn between the water column and the sediment. (Author's abstract)
W90-00853

ORGANIC MARKERS AS SOURCE DISCRIMINANTS AND SEDIMENT TRANSPORT INDICATORS IN SOUTH SAN FRANCISCO BAY, CALIFORNIA.
Geological Survey, Menlo Park, CA.
F. D. Hostettler, J. B. Rapp, K. A. Kvenvolden, and S. N. Luoma.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 7, p 1563-1576, July 1989. 7 fig, 2 tab, 46 ref, 3 append.

Descriptors: *Path of pollutants, *Sedimentology, *Stratigraphy, *San Francisco Bay, *California, *Organic compounds, *Aromatic compounds, *Estuaries, *Water pollution sources, Sediment transport, Marine sediments, Multivariate analysis, Tidal currents.

Sediment samples from nearshore sites in south San Francisco Bay and from streams flowing into that section of the Bay have been characterized in terms of their content of biogenic and anthropogenic molecular marker compounds. The distributions, input sources, and applicability of these compounds in determining sediment movement are discussed. By means of inspection and multivariate analysis, the compounds were grouped according to probable input sources and the sampling stations according to the relative importance of source contributions. A suite of polycyclic aromatic hydrocarbons (PAHs) dominated by pyrene, fluoranthene and phenanthrene, typical of estuarine environments worldwide, and suites of mature sterane and hopane biomarkers were found to be most suitable as background markers for the bay. A homologous series of long-chain n-aldehydes (C12-C32) with a strong even-over-odd carbon number dominance in the higher molecular weight range and the ubiquitous n-alkanes (n-C24-C34) with a strong odd-over-even carbon number dominance were utilized as terrigenous markers. Several ratios of these terrigenous and Bay markers were calculated for each station. These ratios and the statistical indicators from the multivariate analysis point toward a strong terrigenous signal in the terminus of South Bay and indicate net directional movement of recently introduced sediment where nontidal currents had been considered to be minimal or nonexistent and tidal currents had been assumed to be dominant. (Author's abstract)
W90-00854

ANALYSIS OF MALATHION AND ITS BREAKDOWN PRODUCTS IN AQUARIA CONTAINING GOLDEN SHINERS (N. CHRYSOLEUCAS).
University of Southern Maine, Portland. Dept. of Chemistry.
R. G. Stebbins, T. Roy, and T. R. Doane.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 3, p 127-137, 5 fig, 3 tab, 18 ref. USAFOSR RIP Grant No. F49620-85-C-0013/SB.

Descriptors: *Path of pollutants, *Malathion, *Organophosphorus pesticides, *Shiner, *Bioaccumulation, *Fate of pollutants, Hydrolysis, Hydrogen ion concentration, Water chemistry, Calcium, Fish, Insecticides, Water pollution effects.

The 1-ethylmonocarboxylic acid of malathion (MCA) was identified as a metabolite of malathion in the gut of golden shiners (N. Chrysoleucas) (711 + or -66 nanograms/g tissue) exposed to malathion (137 ppb at pH 7.02) for 4 days at 23 C. The

rate of hydrolysis of malathion above pH 7 is first order and pH dependent. The rate of hydrolysis of malathion in aquaria housing the shiners was found to be dependent on the concentration of Ca(++), and sparging the aquaria with air affected the rate. Some of the hydrolysis products of malathion were identified by gas chromatography/mass spectrometry and found to be pH dependent above pH 7. The half-life of malathion at pH 6.8 decreased with increasing Ca(++) concentration. At pH 7.0 the half-life of malathion ranged from 0.10 +or-0.02 to 1.79 +or-0.08 at Ca(++) concentrations of 0 ppm. (Geiger-PTT)
W90-00855

TRACE ELEMENT SPECIATION IN CONTAMINATED SOILS STUDIED BY ATOMIC ABSORPTION SPECTROMETRY AND NEUTRON ACTIVATION ANALYSIS.
Ceske Vysoke Uceni Technicke v Praze. Fakulta Jaderna a Fysikalne Inzenyrska.
For primary bibliographic entry see Field 5A.
W90-00863

PREDICTING THE FATE AND EFFECTS OF CHLORINATED HYDROCARBONS IN A COASTAL MARINE SYSTEM--SOUTH-EAST INDIAN OCEAN.
Port Elizabeth Univ. (South Africa). Dept. of Oceanography.
A. C. De Kock, and D. A. Lord.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 36, No. 3, p 133-138, 1989. 5 fig, 2 ref.

Descriptors: *Path of pollutants, *Mammals, *Chlorinated hydrocarbons, *Fate of pollutants, *Indian Ocean, *Water pollution effects, *Bioaccumulation, Cetaceans, DDD, DDE, DDT, Polychlorinated biphenyls, Tracers, Bioindicators, Lipids, Dolphins.

Blubber samples of dolphins collected in the south-east Indian Ocean all show traces of the persistent organochlorine compounds (polychlorinated biphenyls, DDT, DDE and DDD). The bottlenosed dolphin, which feeds close to shore, showed consistently higher levels than the common dolphin, which feeds further offshore suggesting a higher contaminant load in the coastal waters than in the open ocean. For both species, female cetaceans transfer approximately 80% of their residue load to their offspring during lactation. The DDE/total-DDT ratios indicate an ageing of DDT in marine mammals from the southeast Indian Ocean, implying no major recent input of DDT to this region. It is suggested that organochlorines be used as chemical tracers in determining biological parameters. (Author's abstract)
W90-00867

FLOW INTERRUPTION: A METHOD FOR INVESTIGATING SORPTION NONEQUILIBRIUM.
Florida Univ., Gainesville. Dept. of Soil Science.
M. L. Brusseau, P. S. C. Rao, R. E. Jessup, and J. M. Davidson.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 3, p 223-240, August 1989. 10 fig, 3 tab, 31 ref.

Descriptors: *Herbicides, *Pesticides, *Groundwater pollution, *Soil water pollution, *Organic compounds, *Path of pollutants, *Sorption, *Equilibrium, *Flow measurement, Soil column, Flow characteristics, Fate of pollutants, Mathematical models, Inorganic compounds.

Of the several processes affecting organic contaminant behavior in soil and aquifer systems, sorption is one of the most important. Conceptual and mathematical representations of sorption are often simplified by assuming the establishment of instantaneous local equilibrium; however, data exhibiting deviating behavior from this model have been reported, and sorption nonequilibrium resulting from physical nonequilibrium and intra-organic matter diffusion have been suggested to be the two predominant factors responsible for the nonideal sorptive behavior of nonionic, low-polarity, hydrophobic organic compounds. A flow-interruption method for investigating sorption nonequilibrium is presented. The technique has a greater sensitivity to nonequilibrium than to traditional column experiments and hence provides a greater capacity to investigate nonequilibrium. The technique may provide more reliable determinations of kinetic parameter values. In some situations, the technique may be used to assist in the delineation of mechanism(s) responsible for sorption nonequilibrium. Use of the technique is demonstrated with miscible displacement of the herbicide 2,4-D through saturated soil columns. The sorption nonequilibrium exhibited by 2,4-D is suggested to be a result of intra-inorganic matter diffusion. Experimentally determined values of the sorption rate constant show an inverse relationship to organic matter content. (Author's abstract)
W90-00874

DIFFUSION OF INORGANIC CHEMICAL SPECIES IN COMPACTED CLAY SOIL.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
C. D. Shackelford, D. E. Daniel, and H. J. Liljestrand.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 3, p 241-273, August 1989. 9 fig, 10 tab, 58 ref.

Descriptors: *Path of pollutants, *Liners, *Landfills, *Leachates, *Diffusivity, *Solute transport, *Waste management, *Barriers, *Clays, Soil texture, Advection, Diffusion coefficient, Inorganic compounds, Flow characteristics, Anions, Cations, Leachates, Mass transfer, Chemical analysis, Mathematical studies, Chemical precipitation, Design criteria.

Recent field studies indicate that molecular diffusion controls solute transport in fine-grained soils when the advective component of flow is low. A study was conducted to determine how diffusion of inorganic chemicals in compacted clay soil affects the design of waste containment barriers. The effective diffusion coefficients of anionic and cationic species in a synthetic leachate were measured. Two clay soils were compacted and presoaked to minimize mass transport due to suction in the soil. The results of the diffusion tests were analyzed using two analytical solutions to Fick's second law and a commercially available semi-analytical solution. Mass balance calculations were performed to indicate possible sinks/sources in the diffusion system. Errors in mass balance were attributed to problems with the chemical analysis, the inefficiency of the extraction procedure, precipitation, and chemical complexation. In general, high diffusion coefficient values and conservative designs of waste containment barriers will result if the procedures described in this study are used to determine diffusion coefficients and the adsorption behavior of the solutes is similar to that described in this study. (Author's abstract)
W90-00875

ENUMERATION OF ANAEROBIC AND OLIGOTROPHIC BACTERIA IN SUBSOILS AND SEDIMENTS.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
P. Van Beelen, and A. K. Fleuren-Kemila.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 3, p 275-284, August 1989. 4 tab, 25 ref.

Descriptors: *Fate of pollutants, *Anaerobic bacteria, *Anaerobic conditions, *Oligotrophy, *Groundwater pollution, *Biodegradation, Biomass, Deltas, River systems, Sand, Saturation zone, Fluvial sediments, Peat soils, Microscopy, Culture media, Aerobic conditions, Sandy aquifers, The Netherlands, Pollutant identification.

Many cities and many polluted areas in The Netherlands are situated on river deltas with anaerobic groundwater. Since the biodegradation of xenobiotic compounds at low environmental concentrations is dependent on the biomass of the microflora, the determination of the microbial biomass in anaerobic aquifers is relevant for the potential capacity of these subsoils to degrade organic micropollutants. The microflora of two sandy subsoils saturated with groundwater, a peat soil and a river sediment, were enumerated using epifluorescence microscopy and plate counts on rich and diluted media under aerobic and anaerobic conditions. A novel method was used to obtain both aseptic and anaerobic samples. Direct counts revealed high numbers of bacteria per gram of dry soil, 2,000,000,000 and 80,000,000 for the sandy aquifers; 30,000,000,000 for the peat soil; and 600,000,000,000 for the river sediment. Plate counts on a diluted anaerobic medium showed 200,000, 600,000, and 600,000,000, respectively for the latter three soils. The first soil yielded no colonies on various aerobic and anaerobic media and therefore contained strict anaerobic bacteria whereas the second sandy aquifer contained facultative anaerobes. (Author's abstract)
W90-00876

EVALUATION OF GROUNDWATER VULNERABILITY TO PESTICIDES: A COMPARISON BETWEEN THE PESTICIDE DRASTIC INDEX AND THE PRZM LEACHING QUANTITIES.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
O. Banton, and J. P. Villeneuve.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 3, p 285-296, August 1989. 8 fig, 4 tab, 11 ref.

Descriptors: *Vulnerability, *Groundwater pollution, *Pollution vulnerability, *Pesticides, *Simulation analysis, *Comparison studies, Pesticide kinetics, Pesticide toxicity, Agricultural chemicals, Groundwater pollution, Risks, Resources management, Path of pollutants, Fate of pollutants, Leaching, Water depth, Vadose water, Soil types, Chemical properties, Water quality standards, Indexing.

The current use of pesticides in agriculture is giving rise to an increasing number of cases of groundwater contamination. Some of the approaches to understanding and predicting such risks of contamination are aimed at evaluating the degree of vulnerability of the resource to contamination, through indexation methods or modeling the processes that control the migration of contaminants in soil. The DRASTIC rating system, one of several indexation methods, offers a version adapted for agricultural use. Among the currently available simulation models, the PRZM model has been specifically developed to simulate the fate of pesticides. Results from these two methods were compared, attempting to identify a correlation between the pesticide DRASTIC index and the leaching quantities provided by the PRZM model. No significant correlation was found between their results. The only factors taken into account in both methods that influence the correlation of the results are the depth to groundwater and the vadose zone media type. The most significant conclusion resulting from this work is that chemical characteristics of the potential contaminants, which are not considered in the DRASTIC index, are important, if not critical, when evaluating the vulnerability or the potential for contamination of groundwater by agricultural chemicals. In addition, simulation models appear to be the best tools for evaluating the groundwater vulnerability, because they quantify this pollution potential in terms of physical magnitudes, such as contaminant concentrations, which can be compared with water quality criteria. (Author's abstract)
W90-00877

RIVER QUALITY MODELING: TIME DOMAIN APPROACH.
California Univ., Davis. Dept. of Land, Air, and Water Resources.
F. Morkoc, R. H. Shumway, J. W. Biggar, and D. R. Nielsen.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 663-673, August 1989. 6 fig, 5 tab, 11 ref, append.

Descriptors: *Water quality models, *Model studies, *Water quality management, *Water resources development, *Water supply, *River forecasting, Hydrologic cycle, Chemical properties, Physical

properties, Specific conductivity, Dissolved solids, Discharge capacity, Model studies, Numerical analysis, Correlation analysis, Multivariate analysis, Irrigation, Policy making, Canada.

The decrease in the quality and the quantity of water resources worldwide is of concern to policy makers, managers, and researchers. A better understanding of the physical and the chemical aspects of the hydrological cycle will give improved models that are useful in the decision-making process. River quality and quantity variables such as specific conductance (SPC), total dissolved solids (TDS), and daily mean discharge (DDM) reported for Battle River in Saskatchewan, Canada are analyzed by state space methods. A log transformation is used on DDM data before carrying out the analysis because of order-of-magnitude changes in the data. The SPC and TDS series are divided by 100 for numerical stability. The scatter diagram of the variables indicate a deterministic inversely varying relationship between DDM, SPC, and TDS. There is a positive correlation between SPC and TDS. A trivariate second-order state space model is fitted to the observations, and is used to estimate missing observations and to forecast future values of the variables along with their standard deviation of estimation. The expectation-maximization algorithm and Kalman smoothed estimators are used to estimate the model parameters by the maximum likelihood. Dynamic multivariate models such as this can model the stochastic relationship between variables that are measured in time or space. Such models can improve our understanding of complex systems such as Battle River in terms of irrigation, policy-making decisions, and environmental considerations. (Author's abstract)
W90-00889

ORGANIC POLLUTANTS IN URBAN SEWAGE AND POLLUTANT INPUTS TO THE MARINE ENVIRONMENT. APPLICATION TO THE FRENCH SHORELINE (LES POLLUTANTS ORGANIQUES DANS LES EFFLUENTS URBAINS ET APPORTS POLLUTANTS DANS LE MILIEU MARIN. CAS DU LITTORAL FRANCAIS).
Institut Francais de Recherche pour l'Exploitation de la Mer, Brest. Dept. Environnement Littoral.
M. Marchand, J. C. Caprais, P. Pignet, and V. Porot.
Water Research WATRAG, Vol. 23, No. 4, p 461-470, April 1989. 1 fig, 10 tab, 27 ref. (English summary).

Descriptors: *Water pollution sources, *Wastewater treatment, *Wastewater outfall, *Municipal wastewater, *France, *Estuaries, *Coastal waters, *Pollution load, Pesticides, Organic pesticides, Chlorinated hydrocarbons, Polychlorinated biphenyls, Detergents, Suspended solids, DDT, Lindane, Pentachlorophenol, Toulon, Morlaix.

Organic pollutants in municipal sewage collected from French marine shoreline towns (Toulon, Marseille) or (Nantes, Morlaix) were measured. Concentrations of halogenated hydrocarbons, volatile halogenated hydrocarbons, chlorophenols and anionic detergents were measured both in raw sewage and in effluents from treatment plants. Average daily emission rates/capita varied greatly: suspended matter, 44-71 g; total organic extract, 11-20 g; anionic detergents, 2.2-6.6 g; total hydrocarbons, 0.2-1.8 g; aromatic hydrocarbons: 4-17 mg; chlorinated solvents: 0.1-6.0 mg; pentachlorophenol, 40-110 micrograms; PCBs, 10-60 micrograms; chlorinated insecticides (DDT, lindane), < or = 2-60 micrograms. Three major processes for eliminating organic pollutants are used: (1) adsorption on suspended matter at the primary sedimentation stage and on activated sludge; (2) gas stripping during prolonged aeration in secondary biological treatment; and (3) bacterial degradation during secondary biological treatment. Primary treatment eliminated about 50% of most organic pollutants, and about 50% of suspended matter. In secondary biological treatment plants, elimination rates of the majority of organic pollutants were greater than 90% except for lindane and pentachlorophenol. The estimated quantities of pollutants actually discharged annually into estuarine or coastal marine waters varied greatly depending on the volume of sewage, the sewage treatment system and the nature of organic pollutants. In Toulon (61,000 eq. inhab.) and Morlaix (30,000 eq. inhab.) the concentrations were: anionic detergents: 11-72 tons; total hydrocarbons: 0.9-8.0 tons; chlorinated solvents: 0.4-40 kg; chlorinated insecticides: 0.02-1.0 kg; PCBs: 0.1-0.4 kg. (Author's abstract)
W90-00906

TOXIC CYANOBACTERIA AND WATER QUALITY PROBLEMS--EXAMPLES FROM A EUTROPHIC LAKE ON ALAND, SOUTH WEST FINLAND.
Abo Akademi, Turku (Finland). Dept. of Biology.
T. Lindholm, J. E. Eriksson, and J. A. O. Meriluoto.
Water Research WATRAG, Vol. 23, No. 4, p 481-486, April 1989. 5 fig, 42 ref.

Descriptors: *Eutrophic lakes, *Toxins, *Pathogenic bacteria, *Cyanophyta, *Bacterial toxins, *Water quality, Finland, Lake Ostra Kyrksundet, High-pressure liquid chromatography.

Persistent mass occurrence of the toxic cyanobacterium Oscillatoria agardhii Gomont is reported from Ostra Kyrksundet (area 200 ha, max. depth 22 m, mean depth 8.5 m), a eutrophic lake and freshwater supply on Aland Islands, SW Finland. In August 1987 O. agardhii and a peptide hepatoxin characteristic of this species (as analyzed by HPLC) co-occurred in the upper 10 m layer. The toxin and O. agardhii were still present in the lake after the autumnal overturn and even under the ice in March 1988. The highest toxin concentration (37 micrograms/L) and the highest chlorophyll a values (35 micrograms/L) were recorded at 6 m near the water intake level on Aug 13 1987, when the health authorities stopped the use of the lake as a drinking water reservoir. Several limnological features of the lake e.g. stratification, low transparency, high pH and a fairly high N/P ratio, favor O. agardhii. Persistent blooms of toxic cyanobacteria imply considerable water quality problems and health risks and may also lead to an impoverishment of the fauna in lakes. The observations in Lake Ostra Kyrksundet and previous work on eutrophic freshwater reservoir (with fish and bird kills associated with cyanobacterial blooms) raise some general questions concerning water quality criteria and the monitoring of toxic cyanobacteria in lakes and reservoir. (Author's abstract)
W90-00908

SOIL EFFECTS ON WATER CHEMISTRY IN THREE ADJACENT UPLAND STREAMS AT GLENDYE IN NORTHEAST SCOTLAND.
Aberdeen Univ. (Scotland). Dept. of Soil Science.
R. M. Rees, F. Parker-Jervis, and M. S. Cresser.
Water Research WATRAG, Vol. 23, No. 4, p 511-517, April 1989. 6 fig, 1 tab, 10 ref.

Descriptors: *Acid rain effects, *Water chemistry, *Water pollution sources, *Soil-water-plant relationships, *Peat soils, *Acidification, *Aluminum, *Soil chemistry, Storm runoff, Scotland, Soil types, Organic carbon.

The soils and water chemistry of streams were studied in three superficially similar adjacent upland catchments in northeast Scotland. High stream baseflow total organic carbon concentrations were associated with stream water pH values between 5 and 6 and drainage predominantly from peat. Streams with pH values of 6.8-7.0 and low TOC concentrations at base flow were associated with inputs of water from mineral soils, and were more susceptible to pronounced acidification during storms as the hydrological pathway changed. Differences in relative contributions of water draining mineral soils in the three catchments are reflected also by changes in water chemistry along transect of the streams, and in different relationships between aluminum and stream water organic matter content. The results indicate that soil physical and chemical parameters must be incorporated into water chemistry models that are used to predict long-term effects of changes in deposition of pollutants on water chemistry. (Author's abstract)
W90-00912

BIOCONCENTRATION AND EXCRETION OF BENTHIOCARB AND SIMETRYNE BY CARP.
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
T. Tsuda, S. Aoki, M. Kojima, and H. Harada.
Water Research WATRAG, Vol. 23, No. 4, p 529-531, April 1989. 1 fig, 2 tab, 6 ref.

Descriptors: *Path of pollutants, *Biological magnification, *Pesticides, *Bioaccumulation, *Carp, Tissue analysis, Carbamate pesticides, Triazine pesticides, Herbicides.

Bioconcentration and excretion of benthiocarb (S-p-chlorobenzyl N,N-diethylthiocarbamate) and simetryne (2,4-bis(ethylamino)-6-methylthio-1,3,5-triazine) were studied in carp. The concentrations of both chemicals in muscle and viscera of carp reached plateaus after 12 h exposure. Bioconcentration factors (BCF) of benthiocarb were 25.5 in muscle, 62.7 in liver, 72.7 in kidney and 63.3 (mean, n = 4) in gallbladder over the 168 h exposure period. Similarly, BCF of simetryne were 2.4 in muscle, 13.5 in liver, 8.1 in kidney, and 10.9 in gallbladder over the 72 h exposure period. The excretion rate constants of benthiocarb were 0.10/h for muscle, 0.09/h for liver, 0.13/h for kidney and 0.09/h for gallbladder assuming their processes to be first-order kinetics. Similarly, those of simetryne were 0.44/h for muscle, 0.37/h for liver, 0.29/h for kidney and 0.23/h for gallbladder. (Author's abstract)
W90-00916

IMPACT OF PLASTIC MATERIALS ON IRON LEVELS IN VILLAGE GROUNDWATER SUPPLIES IN MALAWI.
Botswana Dept. of Water Affairs, Gaborone.
For primary bibliographic entry see Field 2F.
W90-00930

STORM PERIOD HYDROCHEMICAL RESPONSE IN AN UNFORESTED SCOTTISH CATCHMENT.
Institute of Hydrology, Wallingford (England).
A. Jenkins.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 4, p 393-404, August 1989. 5 fig, 17 ref.

Descriptors: *Water pollution sources, *Rainstorms, *Rainfall-runoff relationships, *Scotland, *Catchment areas, *Water chemistry, *Acid rain, Hydrogen ion concentration, Conductivity, Runoff, Snowmelt.

The pH, electrical conductivity and runoff response of the Allt a Mharcaidh catchment is assessed for the period 1 November 1985 to April 1986. Hydrographs generated by three distinct types of input are discussed: rain, snowmelt and rain-on-snow. Each produces a distinct response at the catchment outflow and the close relationship between discharge and pH emphasizes the importance of hydrological factors in determining stream acidity. Interpreting the data with a view to identifying hydrological pathways, however, presents conflicting hypotheses. The data show that moorland catchments are susceptible to severe acid pulses, the most acidic being in response to snowmelt. (Author's abstract)
W90-00937

OPTIMIZATION APPROACH FOR GROUNDWATER QUALITY MONITORING NETWORK DESIGN.
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7A.
W90-00943

LAPLACE TRANSFORM GALERKIN TECHNIQUE: A TIME-CONTINUOUS FINITE ELEMENT THEORY AND APPLICATION TO MASS TRANSPORT IN GROUNDWATER.
Waterloo Univ. (Ontario). Inst. for Ground Water

Research.
For primary bibliographic entry see Field 2F.
W90-00949

ION ELUTION THROUGH SHALLOW HOMOGENEOUS SNOW.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. C. Bales, R. E. Davis, and D. A. Stanley.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1869-1877, August 1989. 9 fig, 2 tab, 34 ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Acidification, *Water pollution sources, *Snow, *Ions, Shallow snow, Snowpack, Elution.

Controlled melting of snowpacks in the laboratory demonstrates the importance of the initial distribution of chemical species within the pack (mesoscale) and within the snow grains (microscale) to the timing and relative concentrations of meltwater released from the base of the pack. Acid and salt tracers were applied to homongeneous snow in order to investigate these effects. Species deposited near the top of the pack eluted out considerably before those more uniformly distributed with depth. Also, about 80% of the salts dosed at the top of a 0.4 m pack were removed in the first 20% of the meltwater, versus 70% of a salt dosed at middepth. Both the top and middepth tracers were present in the first fractions of meltwater draining from the pack, however, indicating that there is partial mixing of percolating meltwater with solutes in an immobile surface phase on grains deeper in the pack. Concentration of species on the outside of grains by seasonal metamorphism and on the outside of multigrain particles and clusters during melt freeze will enhance their early removal. Different ions that were present in the snow with the same mesoscale and microscale conditions prior to melt came out at the same relative concentrations; i.e., they did not exhibit preferentially elution. (Author's abstract)
W90-00952

CHARACTERIZATION AND ISOTOPIC COMPOSITION OF ORGANIC AND INORGANIC CARBON IN THE MILK RIVER AQUIFER.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W90-00954

5C. Effects Of Pollution

DEVELOPMENTS IN ECOLOGICAL MODELLING.
Royal Danish School of Pharmacy, Copenhagen. Dept. of Pharmaceutical Chemistry.
For primary bibliographic entry see Field 7C.
W90-00003

DEVELOPMENT, TESTING, AND APPLICATIONS OF NONPOINT SOURCE MODELS FOR EVALUATION OF PESTICIDES RISK TO THE ENVIRONMENT.
Environmental Research Lab., Athens, GA.
L. A. Mulkey, R. F. Carsel, and C. N. Smith.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 383-397, 2 fig, 2 tab, 30 ref.

Descriptors: *Model studies, *Risk assessment, *Water pollution effects, *Pesticides, *Nonpoint pollution sources, *Path of pollutants, Agricultural runoff, Mathematical models, Groundwater pollution, Surface-groundwater relations, Hydrologic models, Comparison studies, Sensitivity analysis, Leaching, Soil-water-plant relationships, Model testing.

Nonpoint source pollution resulting from agricultural production can be analyzed with the assistance of mathematical models. The selection and application of specific models are dependent on many factors related to the nature and areal extent of the pollutant of interest. In cases where pesticide risk to the environment is the concern, the analysis must include estimates of the exposure probabilities. The magnitude, frequency, and duration of pesticide concentrations are required for surface waters draining agricultural areas and for groundwaters recharged through the soil-plant profile. The nonpoint source models used to provide mass loadings for such analyses have been identified and summarized. Five runoff models were described and their differences noted--PRS, CREAMS, CPS, ARM, and HSPF. Although specific differences in model structures exist, sensitivity testing has shown that relative response to major parameters is similar suggesting that all are appropriate for many applications. A new leaching model for estimating threats to groundwater was discussed and typical applications demonstrated. The extension of probability derivations for groundwater problems was described. (See also W90-00001) (Lantz-PTT)
W90-00020

CONTAMINATION, BIOACCUMULATION, AND ECOLOGICAL EFFECTS OF CREOSOTE-DERIVED COMPOUNDS IN THE NEARSHORE ESTUARINE ENVIRONMENT OF PENSACOLA BAY, FLORIDA.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00027

INORGANIC GEOCHEMISTRY OF GROUND WATER AND AQUIFER MATRIX: FIRST-YEAR RESULTS.
Syracuse Univ., NY.
D. I. Siegel, P. C. Bennett, M. J. Baedecker, M. P. Berndt, and D. A. Franzi.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p C17-C20, 2 fig.

Descriptors: *Water pollution effects, *Path of pollutants, *Geochemistry, *Aquifers, *Groundwater quality, *Fate of pollutants, *Inorganic compounds, *Oil pollution, Chemical analysis, Calcium, Magnesium, Sodium, Potassium, Silicon, Iron, Manganese, Aluminum, Hydrogen ion concentration, Alkalinity, Dissolved oxygen, Petrology, Biodegradation.

The effects of oil contamination on the inorganic geochemistry of the surficial aquifer at Bemidji, MN, were investigated in studies of both the aqueous and solid phases. Ninety-six samples of groundwater were collected and analyzed for dissolved Ca, Mg, Na, K, Si, Fe, Mn, Al, and Sr. Some samples were analyzed for unstable field properties (pH, alkalinity, S(2-), NH4, Eh, and dissolved oxygen), anions (Cl and SO4), trace metals (Ni, V, Cr, and Zn) and stable isotopes of carbon and water, depending on the objectives of the particular resampling. Initial groundwater sampling was done from piezometer nests installed along an east-west transect from the contamination zone. These analyses showed that oil degradation has significantly enhanced the dissolution of aquifer minerals. Concentrations of Ca, Mg, Cr, and HCO3 are 2 to 3 times greater in the contaminated area than in background wells. Concentrations decrease with depth, showing that dissolution is greatest at or just below the water table. The areal distribution of major cations, Mn, Si, field pH, and alkalinity form distinct narrow plumes that trend northeastward from the spill site. Preliminary background data on the chemical composition of the silt- and clay-size fractions is consistent with the mineralogical composition determined by petrography, x-ray-energy spectroscopy and x-ray diffractometry. Major minerals of the aquifer are quartz, plagioclase and microcline, and dolomite, which form about 80, 11, and 7% of the drift. Microbial degradation of the oil at the water table has created a reducing geochemical environment. DO and Eh decrease from about 9.0 mg/L and 250 mv (millivolts) in the uncontaminated region to nondetectable DO and -80 mv, respectively, in the major part of the plume. Concentrations of sulfate in the contaminated zone near the water table are generally < 100 millimol/L, but exceed 100 millimol/L in the aquifer. (See also W90-00022) (Lantz-PTT)
W90-00035

MICROBIAL POPULATIONS AND NUTRIENT CONCENTRATIONS IN A JET-FUEL-CONTAMINATED SHALLOW AQUIFER AT TUSTIN, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
G. G. Ehrlich, R. A. Schroeder, and P. Martin.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 83-96, 3 fig, 3 tab, 18 ref.

Descriptors: *Population dynamics, *Microbial degradation, *Biodegradation, *Fate of pollutants, *California, *Limiting nutrients, *Water pollution effects, *Nitrates, *Aquifers, *Fuel, Groundwater pollution, Bacteria, Biodegradation, Nitrogen, Phosphates, Microbiological studies, Water pollution treatment.

JP-5 jet fuel has contaminated 1 hectometer of the shallow aquifer at the US Marine Corps Air Station (Helicopter) in Tustin, CA. A 1.5-m thick clay layer at the bottom of the shallow aquifer provides a barrier to vertical migration to the deeper principal aquifer. Horizontal transport results in slow seepage from the banks of the Peters Canyon channel, which intercepts the shallow aquifer downgradient from the source of contamination. Determinations of bacterial populations in the groundwater indicate that bacterial counts are 100 to 1,000 times higher inside than outside the zone of contamination. Growth on JP-5-inoculated agar plates shows that substantial populations of JP-5-assimilating bacteria are present in the shallow aquifer. Evidence suggests that only a few species of specialized bacteria, presumably those able to assimilate JP-5, are preferentially selected for in the contaminated zone. Laboratory enrichment experiments show that the addition of nitrate plus phosphate stimulates growth and converts a mixture of fuel and water to an emulsion. The presence of carboxylate metabolites in the groundwater suggests that biotransformation of jet fuel hydrocarbons stops short of complete mineralization to inorganic carbon, presumably reflecting oxygen limitation. These findings indicate that injection of inorganic nitrogen, phosphorus, and oxygen might enhance in-situ microbial degradation of jet fuel in the shallow aquifer. (See also W90-00052) (Author's abstract)
W90-00059

EFFECTS OF PENTACHLOROPHENOL ON THE METHANOGENIC FERMENTATION OF PHENOL.
Geological Survey, Menlo Park, CA. Water Resources Div.
E. M. Godsy, D. F. Goerrlitz, and G. G. Ehrlich.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 101-106, 1 fig, 2 tab, 14 ref.

Descriptors: *Water pollution effects, *Pentachlorophenol, *Methane, *Fermentation, *Phenols, *Fate of pollutants, *Biodegradation, *Pesticides, Methanogenesis, Digestion, Biomass, Synergistic effects, Inhibition.

The methanogenic fermentation of phenol at a concentration of 200 mg/L was investigated in the presence of pentachlorophenol (PCP) ranging in concentration from 0.01 to 5.0 mg/L in laboratory digestors. The digestors contained a mixture of mineral salts in a solution and settled sludge from a bench-scale anaerobic digestor (10:1, v/v). The mean rates of methane gas evolution from the digestors indicated that a concentration of 0.05 mg/L PCP or less had no effect on methanogenesis. PCP concentrations of 0.1 and 0.5 mg/L delayed the onset of methanogenesis but did not affect the overall rate. Methanogenesis of phenol did not occur at PCP concentrations greater than 1.0 mg/L. Results of high performance liquid

chromatography analysis of the culture solutions, biomass, and the inner walls of the digestors indicated that PCP was partially biodegraded when the initial concentration was 1.0 mg/L, and was completely biodegraded when the concentration was 0.5 mg/L or less. PCP was not biodegraded at a concentration of 5.0 mg/L. Results indicate that the observed delay before the onset of phenol biodegradation, when the PCP concentrations were between 0.1 and 0.5 mg/L, was relieved by the biodegradation of PCP. (See also W90-00052) (Author's abstract)
W90-00061

ACID RAIN 1986: A HANDBOOK FOR STATES AND PROVINCES.
For primary bibliographic entry see Field 5B.
W90-00063

POLLUTANTS IN THE AIR AND ACIDS IN THE RAIN: INFLUENCES ON OUR NATURAL ENVIRONMENT AND A CHALLENGE FOR EVERY INDUSTRIAL SOCIETY.
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 5B.
W90-00064

FLORIDA ACID DEPOSITION RESEARCH PROGRAM.
Florida State Dept. of Environmental Regulation, Tallahassee. Bureau of Air Quality Management.
S. Gray.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 109-125, 2 fig, 1 tab, 10 ref, append.

Descriptors: *Florida, *Administrative agencies, *Water pollution effects, *Acid rain, *Acid rain effects, *Research priorities, Ecological effects, Economic impact, Legislation, Sulfur dioxide, Model studies, Grants.

The occurrence of acid deposition in Florida, while not at the level experienced by the northeastern United States, is still an area of concern to the state. Three main issues are involved in the acid rain problem: ecological effects, source attribution and economic impacts of new legislation. Prior research has shown that some regions within the state are potentially sensitive to acidic deposition and may have already experienced some ecological declines. Further, research into the direct effects of acid deposition on sensitive aquatic systems and the delineation of sources of acidic precursors is in progress. The economic effects are being addressed through the development of a state and regional model of economic impacts due to proposed federal controls for sulfur dioxide emissions. This work is funded through an Environmental Protection Agency S.T.A.R. grant. (See also W90-00063) (Lantz-PTT)
W90-00068

ATMOSPHERIC DEPOSITION; NORTH DAKOTA'S EXPERIENCE.
North Dakota State Dept. of Health, Bismarck. Div. of Hazardous Waste Management and Special Studies.
For primary bibliographic entry see Field 5A.
W90-00070

MAPPING OF SOILS AND BEDROCK SENSITIVITY TO ACIDIC DEPOSITION IN MANITOBA.
Manitoba Dept. of Environmental Management, Winnipeg. Environmental Management Services Branch.
D. L. Wotton, and P. W. Haluschak.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 396-419, 3 tab, 11 ref.

Descriptors: *Acid rain effects, *Acid rain, *Soil contamination, *Manitoba, *Acid rain effects, *Maps, *Mapping, Path of pollutants.

The Manitoba Department of Environment and Workplace Safety and Health and the Canada-Manitoba Soil Survey cooperatively developed two maps to reflect soils and geological sensitivity to acidic deposition in Manitoba. One map entitled 'Sensitivity of Soils to Acidic Inputs' was intended for interpretation of sensitivity to terrestrial systems and reflects possible effects on forest or agricultural productivity. A second map, 'Potential of Soils and Bedrock to Reduce the Acidity of Incoming Acidic Deposition' was developed to rate soils, surficial and bedrock geology for their potential to reduce incoming acidic deposition prior to its entry into aquatic ecosystems. The maps are at a scale of 1:2,000,000 and have been compatibly developed with other provincial jurisdictions of Western Canada. In consideration of surface soils and bedrock characteristics, areas of high sensitivity to acidic deposition were located on the east side of Lake Winnipeg and in the northwest corner of the province. In these areas, the potential of soils and bedrock to reduce the acidity of incoming acidic deposition is low, similarly indicating a high sensitivity. (See also W90-00063) (Author's abstract)
W90-00074

FIELD ASSESSMENT OF THE EFFECTS OF CONTAMINANTS ON FISHES.
National Fisheries Contaminant Research Center, Columbia, MO.
J. B. Hunn.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-112999. Price codes: A03 in paper copy, A01 in microfiche. Biological Report 88(19), July 1988. 25p, 1 tab, 50 ref, 7 append.

Descriptors: *Monitoring, *Water pollution effects, *Fish, *Data acquisition, Risk assessment, Field tests, Data interpretation, Monitoring, Pesticides.

Two approaches have been used to develop information that helps define the interaction between contaminants (such as pesticides) and fish populations. First, the monitoring of pesticide residues in feral fish populations, and second, investigations of site-specific problems have provided additional information on the effects on wild fish populations. A common feature of risk assessment processes is that tests are conducted and results evaluated in tiers. One often-used protocol consists of four steps that follow the identification of a problem: (1) hazard assessment, (2) dose-response assessment, (3) exposure assessment, and (4) risk characterization. The information provided in this report is designed to help field biologists begin evaluations of potential chemical contaminant problems and determine the extent to which contaminants affect populations of aquatic organisms--especially fish. It is divided into three sections: (1) suggested approaches to defining the problem or initiating risk assessment, (2) background material for investigating emergencies such as a fish kill, and (3) information on approaches to sublethal contaminant problems. Also included are directions for performing a preliminary assessment of fish health by conducting a physical examination, including a sample checklist. Depending on the type of study to be made, some or all of the items on the checklist may be useful. Physical surveys of wild fishes can, for example, be used to establish the frequency of occurrence of abnormal fishes in a specific area. (Lantz-PTT)
W90-00083

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR PYRENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119903. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/X-87/393, July 1987. 73p, 8 tab, 159 ref, append. EPA Contract 68-03-3228.

Descriptors: *Water pollution effects, *Pyrene, *Fate of pollutants, Drinking water, Public health, Aromatic compounds, Daphnia, Fish, Amphibians, Trout, Algae.

Pure pyrene is a colorless solid at ambient temperatures. The presence of tetracene, a common impurity, gives yellow color to pyrene. It is fairly soluble in organic solvents including ethanol, ethyl ether and benzene, but is almost insoluble in water. If released to the aquatic environment, adsorption to particulate organic matter and sediments in water will be an important environmental fate process based on measured sediment K sub oc (organic carbon) values and widespread monitoring of pyrene in ambient sediments. Pyrene has been widely detected in drinking water, surface water, groundwater, rain water, aquatic sediments, many foods, and in the general ambient atmosphere. The average intake from drinking water in the United States is about 2.0 nanograms/day, while the inhalation intake in the United States is about 10-400 nanograms/day. Of six species tested, three arthropods were more sensitive to pyrene than fish or amphibians. Lethal limit values (LC50) of 4, 8 and 20 micrograms/L (ug/L) were reported for Daphnia magna, Artemia salina and Aedes aegypti, respectively. Like some other polyaromatic hydrocarbons (PAHs), the toxicity of pyrene is greatly enhanced by UV light or sunlight. Two algae species were less sensitive to pyrene than the three arthropods, with LC50 sub 50 values of 202 and 332 ug/L for inhibition of photosynthesis. (Lantz-PTT)
W90-00089

SEDIMENT-WATER INTERACTIONS AND CONTAMINANTS IN CORPS OF ENGINEERS RESERVOIR PROJECTS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W90-00098

RESEARCH NEEDS CONCERNING ORGANOTIN COMPOUNDS USED IN ANTIFOULING PAINTS IN COASTAL ENVIRONMENTS.
Science Applications International Corp., Rockville, MD.
M. A. Champ, and D. F. Bleil.
March 1988. 170p, 16 fig, 34 tab, append.

Descriptors: *Antifoulants, *Organotins, *Pesticides, *Water pollution effects, *Organotin compounds, *Toxicity, Paint, Research priorities, Legislation, Marine environment, Structure-activity relationships, Organic compounds.

In the early 1960's, two organotin compounds (tributyltin oxide and tributyltin fluoride) were first used as a molluscicides to kill several species of freshwater snails that were the intermediate hosts of the worms of the genus Schistosoma, which transmit the disease of Schistosomiasis to humans. This immediately led to the use of tributyltin (TBT) moiety as a paint additive in 1961 for its biocidal properties in antifoulant boat bottom paints. The toxicity of organotin compounds to aquatic organisms is thought to increase with the number of butyl substituents from one to three, and then to decrease with the addition of a fourth butyl group. Elemental or inorganic forms of tin (as in mineral deposits or tin can) appear to cause negligible toxicological effects in humans or wildlife. The Navy's decision to implement fleet-wide (approximately 600 ships) use of organotin based antifouling paints precipitated regulatory activities in the US Congress and in the legislatures of several states. On January 8, 1986, the US EPA announced the initiation of a Special Review of all registered pesticide products containing TBT compounds used as additives (biocides) in antifouling paints applied to boat and ship hulls to inhibit the growth of certain aquatic organisms. In initiating the Special Review for TBT, EPA identified significant gaps in the technical information needed to support the registration of TBT used in antifoulant paints. This study's purpose is to provide the National Ocean Policy Board with the technical and policy information required to support the mandat-

ed role of the Federal Government to evaluate, monitor, and control the adverse effects from the use of organotin compounds used as additives (biocides) in antifoulant boat paints. The report has been prepared in five chapters which review and summarize: (1) organotin based antifoulant paints; (2) legislative responsibilities of Federal agencies with respect to evaluating, monitoring, and regulating the use of organotin compounds in vessel antifouling paints, and proposed or pending or enacted legislation by individual states and other Nations; (3) the usage patterns of TBT antifouling paints; (3) the status of scientific knowledge; and (5) research needs and recommendation concerning TBT in coastal waters. (Lantz-PTT)
W90-00142

HEALTH EFFECTS OF DRINKING WATER TREATMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W90-00177

ARTIFICIAL SUBSTRATES AS STANDARD SAMPLING METHOD FOR MACROFAUNA IN DITCHES: A STUDY IN THE VOLGERMEER POLDER (KUNSTMATIGE SUBSTRATEN AIS STANDARD-MONSTER-METHODE VOOR MAKROFAUNA IN SLOTEN: EEN ONDERZOEK IN DE VOLGERMEERPOLDER).
Amsterdam Univ. (Netherlands). Inst. for Taxonomic Zoology.
O. Brinkkemper.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-220496/GAR. Price codes: A08 in paper copy, A01 in microfiche. Jun 1988. 174p, EPA/Grant EPA-R-811771.

Descriptors: *Monitoring, *Biological samples, *Aquatic animals, *Chemical wastes, *The Netherlands, Heavy metals, Water pollution.

The applicability of artificial substrates was studied for use as a standard sampling-method for macrofauna. The artificial substrates, open steel constructions filled with roofing-tiles, were placed at five sampling-sites at successively greater distances from a dumpsite for waste products in the Volgermeerpolder. Between 1960 and 1969 domestic waste and chemical wastes were dumped. The chemical waste was a by-product of the production of pesticides. Toxicity is also found in the water and the silt near the dumping ground. Heavy metals also reach high concentrations. (Author's abstract)
W90-00181

ACID PRECIPITATION: EFFECTS ON FRESH WATER ECOSYSTEMS, JANUARY, 1978-SEPTEMBER 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-870233, Price codes: N01 in paper copy, N01 in microfiche. October 1988. 144p.

Descriptors: *Water pollution effects, *Bibliographies, *Acid rain effects, Algae, Diatoms, Fish physiology, Lakes, Hydrogen ion concentration, Metals, Toxicity, Trace metals.

This bibliography contains 290 citations concerning the effects of acidification of fresh water ecosystems. Studies on algae and diatom distribution, survival and reproduction rates of specific fish species under acid lake conditions, and tolerance to stress caused by acidic conditions in fresh water ecosystems are reported. Effects of water pH on trace metal toxicity to fresh water organisms is briefly considered. Control and reduction of acidification is excluded from this bibliography. (Author's abstract)
W90-00192

EFFECT OF WATER QUALITY ON SURVIVAL OF LAHONTAN CUTTHROAT TROUT EGGS IN THE TRUCKEE RIVER, WEST-CENTRAL NEVADA AND EASTERN CALIFORNIA.
Geological Survey, Carson City, NV.
R. J. Hoffman, and G. G. Scoppettone.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2319, 1988. 21p, 8 fig, 10 tab, 58 ref.

Descriptors: *California, *Fisheries, *Water pollution effects, *Trout, *Water quality, *Truckee River, Fish eggs, Mortality, Heavy metals, Water temperature, Ammonia, Nitrites, Nitrates, Dissolved solids, Groundwater movement, Oxygen deficit, Cadmium, Copper, Iron, Lead, Manganese, Mercury, Zinc.

The U.S. Fish and Wildlife Service has an ongoing program to assess the feasibility of reestablishing naturally spawning populations of Lahontan cutthroat trout in the Truckee River-Pyramid Lake system in Nevada. Previous in situ egg survival studies have documented a 100% mortality of cutthroat trout eggs artificially planted in potential spawning gravels in the Truckee River downstream from Reno. The relation between ambient river quality conditions and the observed mortality of eggs, however, has not been adequately documented. A study was designed to monitor the quality of surface and intragravel water during a trout egg incubation period that began March 10, 1980. Five sites were monitored: two upstream from Reno (background sites), one near Reno, and two downstream from Wadsworth. After an incubation period of about 30 days, poor egg survival was recorded at all sites including an unexpected high mortality at the upstream background sites. Analyses of the data indicated that the principal cause of egg mortality at the two downstream sites was low concentrations (< 5 mg/L) of intragravel dissolved oxygen. Low water temperatures, rather than degraded water quality conditions, largely contributed to the poor survival at the upstream sites. Based on the results of this study, the following were considered unlikely to be mortality factors during the incubation period: (1) high water temperatures; (2) toxicity due to ammonia, nitrite, nitrate, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc; and (3) decreasing intragravel dissolved oxygen caused by in-flow of oxygen poor groundwater. (Author's abstract)
W90-00222

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR BENZO(K)FLUORANTHENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119911. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/X-87/394, August 1987. 47p, 7 tab, 74 ref, append.

Descriptors: *Benzofluoranthene, *Biodegradation, *Toxicity, *Fate of pollutants, Adsorption, Bioaccumulation, Polyaromatic hydrocarbons, Aromatic compounds, Biodegradation, Photolysis, Mussels, Lobster, Clams, Crustaceans.

Benzo(k)fluoranthene is a pale yellow solid at ambient temperatures. It is soluble in ethanol, benzene and acetic acid, but is practically insoluble in water. This compound is susceptible to oxidation by ozone, peroxides and other oxidants. Benzo(k)fluoranthene contains no hydrolyzable functional groups; therefore, hydrolysis is not expected to be significant. The majority of benzo(k)fluoranthene will be present in the particle-sorbed state in water and may not readily photolyze. Therefore, photolysis may be relatively more significant in shallow, clear water than in deep, turbid water. Overall, photodegradation may not be as important as other processes in water. In natural waters, polyaromatic hydrocarbons (PAHs) with four or more aromatic rings are degraded slowly by microbes, and biodegradation is considered to be the ultimate fate process; however, the concentrations of microorganisms capable of oxidizing the hydrocarbons are extremely low in all but heavily polluted fresh and marine waters, and most species of microorganisms cannot use PAH as a sole carbon sources. Microbial oxidation of PAH requires oxygen and will not proceed in anoxic sediments or water. The widespread detection of benzo(k)fluoranthene in various sediments indicates that adsorption to suspended particulate matters and sediments is an important environmental fate process for PAH. Based on a water solubility of 0.00076 parts per million (ppm) at 25 C, the bioconcentration values estimated for benzo(k)fluoranthene suggest significant bioaccumulation potential. PAH, however, may not appreciably bioconcentrate in organisms such as fish that have microsomal oxidase because this enzyme metabolizes PAH. Therefore, the bioaccumulation potential may be dependent on the organism being considered. Benzo(K)fluoranthene has been reported to induce mutations in Salmonella typhimurium strains TA100 and TA-98 when tested in the presence of rat liver S-9 metabolic activation preparation. Data concerning the toxicity of benzo(k)fluoranthene to aquatic organisms could not be be located. Residues species commonly eaten by humans were mussels in Norway, 6-67 ng/g; clams in Japan, 0.12-0.92 ng/g; and lobster from eastern Canada, 0.35 ng/g before impoundment and 169 ng/g after impoundment. (Lantz-PTT)
W90-00236

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR PHENANTHRENE.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119937. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/X-87/392, July 1987. 78p, 7 tab, 76 ref, append. EPA Contract 68-03-3228.

Descriptors: *Biodegradation, *Water pollution effects, *Fate of pollutants, *Toxicity, *Water pollution sources, *Phenanthrene, *Bioaccumulation, Oysters, Fish, Drinking water, Groundwater pollution, Daphnia, Photolysis, Volatilization, Sediments, Industrial wastewater, Mortality, Trout, Lethal limit.

Phenanthrene is a colorless solid at ambient temperatures. It is soluble in a number of organic solvents including ethanol, benzene, toluene, carbon disulfide and ethyl ether, but practically insoluble in water. The aqueous solubility of phenanthrene decreases slightly with the increase of ionic strength and decreases greatly with the lowering of water temperature. It is susceptible to oxidation by ozone, peroxides and other oxidizing agents. The fate and transport of phenanthrene in surface waters depends on the nature of the water. The three processes that are likely to be important for the loss of phenanthrene from water are photolysis, biodegradation and volatilization. In very shallow, fast flowing and clear water, both photolysis and volatilization may be important processes. The half-life of phenanthrene in such waters may be < 1 day. On the other hand, in deep eutrophic ponds, biodegradation may be the most important process for aquatic phenanthrene. Based on its biodegradation half-life in estuarine water, the half-life of the compound in deep eutrophic ponds may be > 36 days. Phenanthrene will moderately bioconcentrate in aquatic organisms. A steady-state bioconcentration factor of 374 has been estimated for phenanthrene in Daphnia pulex. Phenanthrene is widely distributed in the aquatic environment and has been detected in industrial effluents, runoff waters, surface water and sediments, groundwater and drinking water. Phenanthrene has been reported to be present in oysters and fish collected from contaminated waters. Fish collected from contaminated U.S. waters were reported to contain < 20-100 micrograms/kg (ug/kg) of combined phenanthrene/anthracee. The data base for the aquatic toxicity of phenanthrene is limited. The most sensitive of four fish species tested is rainbow trout, which experienced a 10% mortality of eggs and larvae at 1-4 ug/L. Among the nine invertebrate species tested, the lowest reported lethal concentration was 100 ug/L, the 96hr lethal limit for D. pulex. This result conflicts with the only chronic

toxicity study available, in which no toxic effects or reproductive success or survival of D. pulex occurred at 110 ug/L. Bioconcentration and residue monitoring data indicated wide variability in potential for phenanthrene accumulation in various species. Bony fish tended to metabolize and eliminate phenanthrene more rapidly than other aquatic organisms. (Lantz-PTT)
W90-00239

ROLE OF HEALTH-BASED CRITERIA DEVELOPMENT IN USATHAMA'S INSTALLATION RESTORATION PROGRAM.
Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.).
E. L. Etneir.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-013223. Price codes: A03 in paper copy, A01 in microfiche. Report No. ORNL--6489, June 1988. 27p, 2 tab, 8 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Water pollution effects, *Military installations, *Water quality control, *Waste management, *Regulations, Risk analysis, Hazardous materials, Cleanup operations, Standards, Public health.

The purpose of this report is to provide the Project Managers (PM) of the US Army Toxic and Hazardous Materials Agency (USATHAMA) Installation Restoration Program (IRP) with an overview of the means by which various health-based criteria and standards are derived and with definitions of health risk terms frequently used in the risk assessment/risk management scheme. Although certain chemical-specific criteria or standards may apply directly to ambient conditions at a hazardous waste site, many require adjustment to make them relevant and appropriate to the exposure conditions found at a particular site. Basic concepts for derivation of health-based standards and criteria for systemic toxicants and carcinogens are discussed, as well as the actual standards and criteria themselves. These include maximum contaminant level goals, maximum contaminant levels, drinking water health advisories, and ambient water quality criteria for the protection of human health. It can be seen that several basic precepts are inherent in each of the methodologies described, and an understanding of these basic concepts will allow the IRP PM to evaluate the chemical-specific applicable or appropriate regulations developed for cleanup of any Comprehensive Environmental Response, Compensation, and Liability Act of 1989 site. (Lantz-PTT)
W90-00243

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR NIAGARA BLUE 4B.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-120273. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/X-87/389, May 1987. 38p, 3 tab, 36 ref, append. EPA Contract 68-03-3228.

Descriptors: *Water pollution effects, *Niagara Blue, *Dyes, *Fate of pollutants, Sediment contamination, Organic matter, Degradation, Photolysis.

Niagara Blue 4B is a common name for the commercial azo dye Direct Blue 15, which is produced by the coupling of o-dianisidine with 1-amino-8-naphthol-3,6-disulfonic acid under alkaline conditions. It is soluble in water, but is insoluble in most organic solvents. It can be used to dye or stain cellulose, leather, paper, cotton, silk, wool and biological materials, and tint cinematograph. Experimental environmental fate data specific to Niagara Blue 4B are very limited. If released to water, Niagara Blue 4B may be susceptible to significant adsorption because dyestuffs by their substantive nature (ability to be exhaustively deposited from aqueous baths to fibers) are likely to be adsorbed onto both silts and sediment of rivers and lakes. Removal of adsorbed Niagara Blue 4B may occur by anaerobic biodegradation. In general, direct dyes are expected to be relatively stable to direct photolysis in natural waters. But humic materials in natural water have been found to strongly accelerate the indirect photodecomposition of azo dyes. Hydrolysis, volatilization and bioconcentration are not expected to be significant. Apparently, indirect photolysis, microbial degradation and adsorption are the important fate processes in water. Occupational exposure to Niagara Blue 4B occurs during its production and its use in dyeing. Wastewater effluents are probably the major source of release to the environment. Ambient monitoring data could not be located in the available literature. (Lantz-PTT)
W90-00247

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR PHTHALIC ACID ESTERS (PAES).
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-120158. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/X-87/384, September 1987. 227p, 49 tab, 395 ref, append. EPA Contract 68-03-3228.

Descriptors: *Toxicity, *Water pollution effects, *Esters, *Phthalates, Organic compounds, Bacteria, Aquatic environment, Bioaccumulation, Fate of pollutants, Resource Conservation and Recovery Act, Public health, Environmental effects.

This report was prepared to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). It is difficult to draw conclusions about the relative toxicity of phthalic acid esters to aquatic biota because of the large variability in toxicity of each ester to different species. Most of the phthalic esters cause toxic effects at < or = 3.2 mg/L. The lowest concentration reported to cause toxic effects was 0.003 mg/L di(2-ethylhexyl) phthalate, which caused decreased production of offspring by Daphnia magna. Although there are large differences in species sensitivity among major taxonomic groups, none of these groups except bacteria are especially more or less sensitive than other groups. The available information concerning freshwater and saltwater species indicated no difference in phthalate ester toxicity between freshwater and saltwater environment. Many investigators have reported toxic effects of phthalates at concentrations greater than their aqueous solubility; however, the data indicate that all of the phthalates except dihexyl, dinonyl, di-n-decyl and diisodecyl phthalates were toxic to at least one species at concentrations near or below their solubility. Information concerning residues of phthalic acid esters in aquatic biota suggests that accumulation is determined primarily by the degree to which species can metabolize and eliminate them. Fish generally have a well-developed mechanism in this regard and therefore do not accumulate phthalates to a great extent. (Lantz-PTT)
W90-00253

FATE AND EFFECTS OF CRUDE OIL, DISPERSANTS, AND CHEMICALLY DISPERSED OIL IN A WADDEN SEA ECOSYSTEM: CHEMICAL ANALYSES (EINFLUSS UND AUSWIRKUNGEN VON ROHOEL, DISPERGATOREN UND CHEMISCH DISPERGIERTEM OEL AUF DAS OEKOSYSTEM WATTENMEER: CHEMISCHE ANALYSESN).
Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-00261

TOXIC EFFECTS OF METALS ON FISH: EVALUATION OF PHYSIOLOGICAL TEST METHODS (TOXISKA EFFECKTER AV METALLER PA FISK: PROVNING AV FYSIOLOGISK TESTMETDIK).
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
A. Larsson, C. Haux, and M. L. Sjoebeck.
Available from National Technical Information Service, Springfield, VA 22161 as DE88752945/GAR. Price codes: A04 in paper copy, A01 in microfiche. 1986. 68p, 8 fig, 4 tab, 66 ref. English summary.

Descriptors: *Toxicity, *Fish physiology, *Heavy metals, *Water pollution effects, Lakes, Coastal waters, Monitoring, Immune defense, Ion regulation, Glucose homeostasis, Field tests, Laboratory tests.

Physiological methods, previously used as health indicators in laboratory investigations on fish exposed to environmental pollutants, have been applied to feral fish living in metal-polluted coastal waters and lakes. This report summarizes the most important results and experiences of the field and laboratory investigations. The results show that clinical physiological methods may be very sensitive instruments for detecting and diagnosing sublethal disturbances in fish living in metal-polluted waters. However, the investigations also point to possible pitfalls and many problems of crucial importance for evaluation of the test results. Aberrant values for several physiological parameters in fish indicate that metal pollution has a profound influence on important physiological functions, such as immune defense, ion regulation and glucose homeostasis. Good agreement was found between effects noted in fish exposed to metals under natural field conditions and those found in laboratory tests. Also given is a proposal for test strategy and selection of suitable physiological test parameters for future health investigations on fish in metal-polluted coastal waters and lakes. (Author's abstract)
W90-00271

EFFECTS OF ACID DEPOSITION ON THE CATCHMENT AREA OF LAKE MARSJOEN-BASIC STUDY (HAPPAMAN LASKEUMAN VAIKUTUKSISTA MARSJON-JARVEN VALUMA-ALUFELLA PRUSELVITYS).
Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.
I. Uotila.
Available from National Technical Information Service, Springfield, VA 22161 as DE88752825/GAR. Price codes: A06 in paper copy, A01 in microfiche. KTM/E-D-137, August 1987. 107p, 22 fig, 5 tab, 17 ref. English summary.

Descriptors: *Finland, *Acid rain, Sulfur, Nitrogen, Acid deposition, Alkalinity, Buffer capacity.

Evidence of the acidification of soil and water courses observed in Europe and North America has also been found in Finland in recent years. A study into acidification, financed by Imatran Voima Oy (IVO) and the Ministry of Trade and Industry, has been carried out in Inkoo, in the small, remote Marsjoen lake and its catchment which is situated in the vicinity of a coal-fired power plant.The objective of the study was to establish the quality of the air-transported compounds and their effects on the ecosystem. During the research period, the pH of the rain water in open areas was 4.0-5.0, and under the canopy 3.0-4.5. The annual sulfur deposition was some 1.0 g/sq m, but including the canopy throughfall, the average deposition in the area totalled some 1.7 gS/sq m annually. Total nitrogen deposition averaged 0.9 gN/sq m annually. The strong acid in the precipitation is caused 75% by sulfuric acid and 25% by nitric acid. The alkalinity values of the lake were relatively high and its buffer capacity has been sufficient to neutralize the acid deposition so far. No signs of acidification in water plants and fishes were observed. The groundwater studies; however, evidenced a decrease in the alkalinity level. The state of forests and forest lands was normal. The ion budget indicates that the buffer capacity of the soil has been sufficient to neutalize the acid load so far. Acidification of the catchment

area thus does not seem to be a concern of the near future. (Author's abstract)
W90-00276

RESPIRATION AND OSMOREGULATION OF THE ESTUARINE CRAB, RHITHROPANOPEUS HARRISII (GOULD): EFFECTS OF THE HERBICIDE, ALACHLOR.
Duke Univ., Beaufort, NC. Marine Lab.
D. W. Diamond, L. K. Scott, R. B. Forward, and W. Kirby-Smith.
Comparative Biochemistry and Physiology (A) CBPAB5, Vol. 93, No. 2, p 313-318, 1989. 6 fig, 1 tab, 25 ref. Environmental Protection Agency, Contract No. CR813415-01.

Descriptors: *Water pollution effects, *Ecological effects, *Herbicides, *Estuarine environment, *Crabs, *Alachlor, *Respiration, *Osmoregulation, Salinity, Sublethal effects, Oxygen requirements.

The effects of a sudden decrease in salinity and exposure to sublethal concentrations of the herbicide, Alachlor, on osmoregulation and respiration of the crab, Rhithropanopeus harrisii, were studied. Crabs were hyperosmotic regulators at salinities below 24 ppt and became hypoosmotic at higher salinities. Upon a salinity decrease from 20 to 1 ppt, crabs adjusted their haemolymph osmolality to a stable hyperosmotic level in eight hours. Alachlor concentrations to 50 ppt did not affect this adjustment. A salinity decrease from 10 to 0 ppt elevated oxygen consumption rates and the critical oxygen tension. This response was unaffected by Alachlor concentrations as high as 25 ppm. (Author's Abstract)
W90-00278

EFFECT OF POLLUTION ON THE BACTERIAL COMMUNITY STRUCTURE IN THE COASTAL WATERS OF THE EASTERN MEDITERRANEAN SEA.
Israel Oceanographic and Limnological Research Ltd., Haifa.
B. Cavari, and R. R. Colwell.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 147-157, 1988. 1 fig, 5 tab, 16 ref. United States-Israel Binational Science Foundation, Grant No. 2350181; National Science Foundation Systematics Grant No. BSR-82-08418; Office of Naval Research Contract No. N00014-81-K-0638.

Descriptors: *Marine bacteria, *Water pollution effects, *Bacteria, *Coastal waters, *Mediterranean Sea, *Domestic wastes, *Chemical wastes, Culture media, Adenosine triphosphate, Taxonomy, Microbiological studies, Israel, Coal, Species composition, Species diversity.

Several microbiological methods were used to evaluate the changes in the naturally occurring bacterial communities along the coastline of Israel near ocean sites where domestic and chemical wastes are disposed and where coal unloading occurs. The methods included the use of various culture media and numerical taxonomy to examine the diversity of bacterial populations, microscopic examination of total bacteria, uptake of radiolabeled substrates, and adenosine triphosphate (ATP) measurement. Heterotrophic activity as measured by bacterial uptake of labeled amino acids and ATP measurement proved most useful in the assessment of pollution in natural aquatic systems. Both the methods were sensitive and reliable. Also, the results could be obtained within 24 hours after sampling. These two methods showed that both bacterial biomass and activity increased with time in surface waters at the coal operated power station. It was also concluded that a short time after the dumping of wastes into the Mediterranean Sea off the coast of Israel ended, bacterial biomass and activity returned to values measured at control sites. Numerical-taxonomy analyses of taxonomic data for pure cultures that were obtained from the sites sampled in this study demonstrated that succession of bacterial species occurred at those sites. However, due to the limited data, it was not possible to identify to what extent this was due to the presence of pollutants. (Gadsby-PTT)
W90-00286

HETEROTROPHIC PROCESSES IN EUTROPHICATED AQUATIC MARINE ENVIRONMENTS.
Centre Univ. de Luminy, Marseille (France).
M. Bianchi, F. Van Wambeke, and A. Bianchi.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 159-166, 1988. 2 fig, 2 tab, 23 ref.

Descriptors: *Water pollution, *Aquatic productivity, *Marine environments, *Mineralization, *Eutrophication, *Heterotrophic microorganisms, *Plankton, Marseilles, Aquatic environment, Marine bacteria, Marine algae, Carbon, Phosphorus, Nitrogen, Biomass, Chlorophyll a, Microplankton.

To assess the mineralization and production process within microplanktonic networks, microbial activities under both laboratory and field conditions were evaluated. In the experimental study, allochthonous inputs into the Mediterranean Sea were simulated in large batch experiments and the behavior of the different compartments of the microplanktonic ecosystem followed. The mineralization of a nitrogen rich organic input is quite independent of the presence of concomitant mineral input. Autotrophic production by phytoplanktonic microalgae is delayed by the competition with bacteria because of limited nutrients such as phosphorus. The extent of the eutrophication process is dependent not only on amounts of allochthonous compounds, but also on their C:P:N ratios. Field studies were carried out in two areas near Marseilles: in an area receiving urban sewage, and in the Rhone river plume. On average, the various indicators of bacterial activity were ten times greater in the heavily polluted water compared to the reference site. The bacterial biomass showed a drastic drop and in the heavily polluted areas, bacterial productivity was high as shown by the values for the frequency of dividing cells. Bacterial activity and biomass were dependent on substrate concentration. The chlorophyll a contained 50% pheopigments, indicating unhealthy cells or allochthonous damaged chlorophyll. (Gadsby-PTT)
W90-00287

UPTAKE OF CADMIUM BY MARINE BACTERIA.
Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
G. N. Flatau, R. L. Clement, and M. J. Gauthier.
Progress in Oceanography POCNA8, Vol. 21, No. 2, p 181-188, 1988. 10 fig, 20 ref.

Descriptors: *Path of pollutants, *Bacterial physiology, *Water pollution effects, *Cadmium, *Marine bacteria, Metabolism, Respiration, Bioaccumulation, Tolerance, Resistance, Inhibition, Adsorption, Absorption, Aerobic bacteria.

The uptake of cadmium by marine bacteria in relation to their metabolic activity and their resistance to cadmium were studied. Strictly aerobic strains accumulated less cadmium than did facultatively aerobic ones, and facultatively aerobic strains accumulated more metal under aerobic conditions than under anaerobic conditions. Irrespective of their respiratory types, sensitive strains accumulated more cadmium than did tolerant and resistant ones. A strictly aerobic, sensitive strain was chosen to investigate the role of respiration and energy in cadmium accumulation. Accumulation of cadmium was determined to depend on the nature of the medium. The cell membrane exposed to cadmium plays an important role, indicating a gradual impairment of the cell membrane corresponding to a gradual increase in accumulation. The inhibition of respiration was one of the effects of cadmium on bacterial cells. Respiratory activity of cells exposed to 1 or 5 mg of cadmium per liter was similar to that of non-exposed cells, but it decreased in cells exposed to 10mg/liter, and was strongly inhibited in cells exposed to 20 and 50 mg/liter. The uptake of cadmium in mineral solutions increased with the metal concentration in the medium, and the accumulation rate was a logarithmic function of the dose. The uptake of cadmium from a nutrient medium supplemented with cadmium was a linear function of the dose indicating a probable adsorption rather than an absorption. However, test cells were not killed by exposure to high doses of cadmium. (Gadsby-PTT)
W90-00289

POSSIBLE HEALTH EFFECTS OF HIGH MANGANESE CONCENTRATION IN DRINKING WATER.
Patras Univ. (Greece). School of Health Sciences.
For primary bibliographic entry see Field 5F.
W90-00293

TOXICITY AND BIODEGRADATION OF PHTHALIC ACID ESTERS UNDER METHANOGENIC CONDITIONS.
New York Univ., NY. Inst. of Environmental Medicine.
For primary bibliographic entry see Field 5B.
W90-00310

SURVIVAL, REPRODUCTION AND BIOCONCENTRATION IN INVERTEBRATES AND FISH EXPOSED TO HEXACHLOROBENZENE.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W90-00312

ALLOZYME GENOTYPE AND TIME TO DEATH OF MOSQUITOFISH, GAMBUSIA AFFINIS (BAIRD AND GIRARD), DURING ACUTE EXPOSURE TO INORGANIC MERCURY.
Savannah River Ecology Lab., Aiken, SC.
S. A. Diamond, M. C. Newman, M. Mulvey, P. M. Dixon, and D. Martinson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 613-622, 1989. 1 fig, 4 tab, 52 ref. U.S. Department of Energy Contract DE-AC09-76SR00819.

Descriptors: *Enzymes, *Genetics, *Lethal limit, *Gambusia, *Heavy metals, *Mercury, *Water pollution effects, *Toxicity, Genetic plasticity, Fish, Population exposure.

Genetic plasticity in a mosquitofish (Gambusia affinis Baird and Girard) population was examined relative to acute mercury toxicity. Genotypes at eight loci (isocitrate dehydrogenase-1 and isocitrate dehydrogenase-2, mannosephosphate isomerase, glucosephosphate isomerase-2, fumarate hydratase, malate dehydrogenase-1, leucylglycylglycine peptidase and phenylalanylproline peptidase) were scored using starch gel electrophoresis. Two null hypotheses were tested: (a) time to death does not differ between genotypes at individual loci and (b) time to death does not differ with multiple-locus heterozygosity. Genotypes at three of the eight loci displayed significant effects on mosquitofish time to death. Multiple-locus heterozygosity also had a significant effect on time to death. Significant amounts of genetic plasticity were found in a population of mosquitofish with no previous exposure to inorganic mercury. (Author's abstract)
W90-00313

TOXICITY OF 2-SEC-BUTYL-4,6-DINITROPHENOL (DINOSEB) AND MONOSODIUM METHANEARSONATE (MSMA), INDIVIDUALLY AND IN A MIXTURE, TO CHANNEL CATFISH (ICTALURUS PUNCTATUS) AND FATHEAD MINNOWS (PIMEPHALES PROMEALAS).
J. R. Skelly.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 623-628, 1989. 2 tab, 10 ref.

Descriptors: *Herbicides, *Catfish, *Fathead minnows, *Water pollution effects, *Pesticide toxicity, *Synergistic effects, Fish, Dinoseb, Monosodium methanearsonate, Toxicity.

The toxicity of technical-grade dinoseb, technical monosodium methanearsonate, several formulations of each and a mixture of the two were tested using channel catfish (Ictalurus punctatus Rafinesque) and fathead minnows (Pimephales promelas

Rafinesque) under standard conditions at 12 C in soft, reconstituted water. The 96-h LC50s for technical dinoseb were 0.058 mg/l for channel catfish and 0.088 gm/l for fathead minnows. Differences among Vertac General, Vertac Selective, Premerge 3, Gebutox, and technical dinoseb did not affect dinoseb toxicity to either fish species. The 96-h LC50s for technical monosodium methanearsonate were 2390 mg/l for channel catfish and 1210 mg/l for fathead minnows. Formulation had a measurable effect on monosodium methanearsonate toxicity, with the Daconate and Daconate 6 formulations nearly an order of magnitude more toxic than technical monosodium methanearsonate and Bueno 6 to both fish species. The mixture or joint toxicity of technical dinoseb and technical monosodium methanearsonate was greater than additive (synergistic), with additive toxicity indices for channel catfish and fathead minnows of 0.51 and 5.78, respectively. (Author's abstract)
W90-00314

CHRONIC EFFECTS OF CONTAMINATED SEDIMENTS ON THE URCHIN LYTECHINUS PICTUS.
Southern California Coastal Water Research Project, Long Beach.
B. E. Thompson, S. M. Bay, J. W. Anderson, J. D. Laughlin, and D. J. Greenstein.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 629-637, 1989. 6 fig, 2 tab, 26 ref.

Descriptors: *Sublethal effects, *Sediment contamination, *Echinoderms, *Heavy metals, *Water pollution effects, Population exposure, California, Zinc, Copper, Cadmium, Lytechinus, Sediments, Sludge, Biological magnification, DDT, Polychlorinated biphenyls.

The urchin, Lytechyinus pictus, one of the most abundant species on the mainland shelf off southern California, was exposed to three of the most contaminated sediment types in the region and a control (reference) sediment. Mortality, growth, gonad production and bioaccumulation were measured in the laboratory for 60 days in flow-through experiments. Significant mortality (49 %) occurred in Santa Monica Bay sludge outfall sediment. Growth rates were significantly reduced in sediments from Los Angeles Harbor, Palos Verdes sewage outfall and Santa Monica Bay sludge outfall. Both male and female gonad production was significantly decreased in the Santa Monica Bay sludge and Palos Verdes outfall sediments. Gonads accumulated up to 12.6 ppm DDTs and 7.4 ppm polychlorinated biphenyls but decreased in concentrations of Zn, Cu and Cd. The biological effects measured could have been caused by several types of contaminants and were significantly correlated with many of the contaminants measured in the sediments. (Author's abstract)
W90-00315

INTERACTION OF HUMIC ACID WITH SELECTED TRACE METALS: INFLUENCE ON BIOACCUMULATION IN DAPHNIDS.
Northeast Louisiana Univ., Monroe. School of Pharmacy.
R. A. Stackhouse, and W. H. Benson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 7, p 639-644, 1989. 4 tab, 29 ref.

Descriptors: *Trace metals, *Water pollution effects, *Daphnia, *Bioaccumulation, *Humic acids, Cadmium, Chromium, Synergistic effects.

The influence of humic acid on the bioaccumulation of Cd, Cr VI and two forms of Cr III was evaluated using a common freshwater cladoceran, Daphnia magna. Humic acid (0.5, 5 and 50 mg/l) had a much greater influence on the bioaccumulation of Cd and Cr III than of Cr VI. At only one time point (96 hours) did the 50 mg/l humic acid significantly decrease the bioaccumulation of Cr VI. The remaining concentrations of humic acid (0.5 and 5 mg/l) had no influence on Cr VI bioaccumulation. However, with both forms of Cr III, 50 mg/l humic acid significantly decreased bioaccumulation, while 0.5 and 5 mg/l humic concentrations either decreased or had no influence on bioaccumulation. The results of the Cd-humic acid interaction were much more variable than those obtained with Cr VI or Cr III. The bioaccumulation of Cd was increased, decreased or not influenced by humic acid, depending on the concentration of humic acid and the exposure period examined. (Author's abstract)
W90-00316

ACID RAIN, CATION DISSOLUTION, AND SULPHATE RETENTION IN THREE TROPICAL SOILS.
University of Agricultural Sciences, Bangalore (India).
S. G. Patil, V. A. K. Sarma, and G. W. van Loon.
Journal of Soil Science JSSCAH, Vol. 40, No. 1, p 85-93, March 1989. 2 fig, 3 tab, 21 ref.

Descriptors: *Cations, *Sulfates, *Soil chemistry, *Acid rain effects, *Acid rain, *Soil physical properties, *Tropical regions, Clays, Calcareous soils, Soil contamination, Hydrogen ion concentration, Cation exchange.

Surface and subsurface samples of three tropical soils were examined with respect to their interaction with dilute solutions of sulfuric acid of pH 3. In calcareous clayey samples with a large cation exchange capacity the H(+) was replaced by an equivalent concentration of metal cations which remained in solution along with SO4(--) as counterion. In a coarse-textured neutral soil with small cation exchange capacity, there was less chemical interaction and a major proportion of the H2SO4 remained unchanged in the equilibrium solution. Another soil exhibited considerable ability to remove SO2(--) from solution and, therefore, the total ionic concentration was greatly reduced. Other samples showed behavior which was intermediate to these three types. The ability to adsorb SO4(--) is one of the most important factors which determines the nature of the interaction of soil with dilute sulfuric acid. This ability was shown to be affected by the content of hydrous sesquioxides and organic matter in these soils. (Author's abstract)
W90-00323

EFFECTS OF SOME CHEMICAL FACTORS ON THE LARVAE AND ADULTS OF SCAPHARCA BROUGHTONII (SCHRENEK), (IN CHINESE).
C. Juemin, W. Enming, and L. He.
Hai Yang Yu Hu Chao (Oceanologia et Limnologia Sinica) HYHCAG, Vol. 20, No. 1, p 15-22, 1989. 13 tab, 7 ref. English summary.

Descriptors: *Acid rain effects, *Water pollution effects, *Population exposure, *Larvae, *Sublethal effects, *Lethal limit, *Fish populations, Mortality, Aquatic animals, Survival, Morbidity, Hydrogen ion concentration.

The effects of S(ppt), NH3-N, pH and dissolved oxygen on the larvae and adults of the Scapharca broughtonii were studied. The survival rate of the larvae is more than 93% in the salinities 21.50-39.60 ppt within 24 h of exposure. For 1-3 year-old groups, the medium lethal time in the same salinities reduces along with the increase in age. The NH3-N concentration for larvae TL sub 50 is 366+66 ppb. The medium lethal time increases with age for 1 to 3 year-old groups in the same TL sub 50 of NH3-N. More than 95% larvae survived in pH 7.5-8.5 within 24 h. However, beyond the range of these pH values the mortality of the larvae increases. As pH value is 6.0 or 9.0, the TL sub 50 is 0.21 mg/L. Both adult and larvae can endure the low dissolved oxygen. The relationship between the attachment, metamorphosis and S (ppt), NH3-N and pH have also been studied. (Author's abstract)
W90-00374

NUTRIENT FLUX THROUGH A LOBLOLLY PINE FOREST FLOOR USING SIMULATED RAINFALL.
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
For primary bibliographic entry see Field 5B.
W90-00388

BACTERIAL COMMUNITY STRUCTURE AND FUNCTION ALONG A HEAVY METAL GRADIENT.
Indiana Univ.-Purdue Univ. at Fort Wayne. Dept. of Biological Sciences.
D. Dean-Ross, and A. L. Mills.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 8, p 2002-2009, August 1989. 1 fig, 8 tab, 27 ref.

Descriptors: *Heavy metals, *Water pollution effects, *Indiana, *Aquatic bacteria, *Sediments, Rivers, Lead, Copper, Cadmium, Zinc, Nickel, Species diversity, Hydrogen ion concentration.

The response of the planktonic, sediment, and epilithic bacterial communities to increasing concentrations of heavy metals was determined in a polluted river. None of the communities demonstrated a pollution-related effect on bacterial numbers (viable and total), heterotrophic activity, resistance to Pb or Cu, or species diversity as determined by either the Shannon-Wiener diversity index or rarefaction. The lack of correlation between concentrations of heavy metals and resistance in the sediment bacterial community was investigated and found to be due at least in part to the high pH of the river water and the resultant reduction in heavy metal toxicity. The three different communities demonstrated characteristic profiles based on the relative abundances of bacterial strains grouped according to functional similarities. The lack of gradient-related effects on the diversity indices is in agreement with bacterial activity measurements which suggest that heavy metals are not exerting deleterious environmental effects under the conditions prevailing in the Fort Wayne river system. (Author's abstract)
W90-00394

EFFECTS OF SUBLETHAL EXPOSURE TO COPPER ON DIEL ACTIVITY OF SEA CATFISH, ARIUS FELIS.
Texas A and M Univ., College Station. Dept. of Biology.
C. W. Steele.
Hydrobiologia HYDRB8, Vol. 178, No. 2, p 135-141, July 14, 1989. 1 fig, 2 tab, 37 ref. NSF, IDOE Division grant OCE76-84416.

Descriptors: *Heavy metals, *Copper, *Water pollution effects, *Toxicity, *Catfish, *Fish behavior.

The effect of sublethal exposure to Cu on the diel activity of sea catfish, Arius felis, was examined after 72 h static exposure to Cu (0.0, 0.05, 0.1, or 0.2 mg/l). The locomotor behavior of 28 individual fish was electronically monitored in a 16-compartment rosette tank. Activity was quantified by the number of entries into compartments per hour. Controls and Cu-exposed fish (0.05 mg/l) behaved similarly after treatment and displayed no significant effects of handling or Cu exposure on diel activity. However, fish exposed to 0.1 and 0.2 mg/l Cu were hyperactive immediately following exposure; these fish had significantly greater numbers of entries into compartments per hour for entire 24-h monitoring periods ($P<0.01$) and for the 12 h of photophase ($P<0.001$) and of scotophase ($P<0.001$) than fish in the other two experimental groups. The normal diel activity cycle was abolished. Additionally, exposure of fish to Cu at 0.1 and 0.2 mg/l resulted in significantly less variability in activity ($P<0.05$) compared to control fish and those exposed to 0.05 mg Cu/l. (Author's abstract)
W90-00404

EFFECTS OF COPPER ON THE ULTRASTRUCTURE OF SCENEDESMUS QUADRICAUDA AND CHLORELLA VULGARIS (EFFETS DU CUIVRE SUR L'ULTRASTRUCTURE DE SCENEDESMUS QUADRICAUDA ET CHLORELLA VULGARIS).
Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.

C. Bastien, and R. Cote.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 7, No. 1, p 51-71, 1989. 24 fig, 76 ref. English summary.

Descriptors: *Heavy metals, *Copper, *Water pollution effects, *Toxicity, *Algae, *Chlorella, *Scenedesmus.

Two experiments were done to study the effects of various concentrations of Cu on the ultrastructure of S. quadricauda and C. vulgaris 2). Batch cultures were utilized, with Cu concentrations of 25, 50, 100, 250, 500, 1000, and 2500 microgram/l. S. quadricauda appeared very tolerant to Cu and showed some growth at a dose as high as 2500 microgram/l. However, C. vulgaris was much more inhibited by Cu. In the case of S. quadricauda, the Cu concentration correlated significantly with the occurrence of electron-dense inclusions. The density of the latter suggests their implication in the tolerance of the species. Dislocation of cell colonies was also observed at concentrations of 500 microgram/l or more. In the case of C. vulgaris, osmotic changes and damage to the membranes and the mitochondria were observed. An increase in Cu concentration was followed by a slight increase in the occurrence of the membranous organelles, of electron-dense inclusions and of inclusion density. At a dose of 250 microgram/l cells showed severe alterations and starch accumulation. (Author's abstract)
W90-00406

ENVIRONMENTAL BEHAVIOR OF POLYCHLORINATED MONO-METHYL-SUBSTITUTED DIPHENYL-METHANES (ME-PCDMS) IN COMPARISON WITH POLYCHLORINATED BIPHENYLS (PCBS): PART II. ENVIRONMENTAL RESIDUES AND AQUATIC TOXICITY.
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-00436

ASSESSMENT OF RELATIVE TOXICITY OF CHLORINATED DIBENZO-P-DIOXINS, DIBENZOFURANS, AND BIPHENYLS IN LAKE ONTARIO SALMONIDS TO MAMMALIAN SYSTEMS USING TOXIC EQUIVALENT FACTORS (TEF).
Bayfield Inst., Burlington (Ontario).
A. J. Niimi, and B. G. Oliver.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1413-1423, 1989. 3 tab, 41 ref.

Descriptors: *Water pollution effects, *Dioxins, *Toxicity, *Chlorinated hydrocarbons, *Lake Ontario, *Fish, Toxic equivalent factors, Salmonids, Dibenzofurans, Biphenyls.

Concentrations of chlorinated dibenzo-p-dioxins and dibenzofurans were measured in four species of Lake Ontario salmonids and related to congener-specific PCB analyses for the same fish reported in a previous study. The toxicity of these chemical concnetrations to mammalian systems were evaluated using toxic equivalent factors (TEF), based on composite, AHH induction, and thymic atrophy indices. Total dioxin levels ranged from 46-290 ng/kg in whole fish and 60-366 ng/kg in muscle composite samples. Levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in while fish ranged from 6-20 ng/kg which represented 60% of total T4CDDs and 10% of total dioxins. Heptachlorodibenzo-p-dioxins (H6DDDs) was the most common isomeric group representing an average of 39% of the total dioxin concentrations. High levels of octachlorodibenzo-p-dioxin (OCDD)6 were observed in lake trout and coho salmon, but not in rainbow or brown trout. Total furan levels were about 25% lower than total dioxin concentrations. The 2,3,7,8-(total chlorodibenzofurans (TCDF) represented most of the T4DCFs monitored, although no comparative analyses were made for the other furans because of the low chemical concentrations of other isomers. The results indicated the PCB levels monitored in these species are potentially 5-fold to 10-fold, or more, toxic to mammals than the levels of dioxins of furans. It must be unequivocally stated that this assessment was based in biochemical responses observed in rats, and it would be presumptuous to apply these results to higher mammalian species. (Miller-PTT)
W90-00437

ENVIRONMENTAL IMPACT OF THE USE OF IVERMECTIN: ENVIRONMENTAL EFFECTS AND FATE.
Merck Sharp and Dohme Research Labs., Rahway, NJ.
B. A. Halley, T. A. Jacob, and A. Y. H. Lu.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1543-1563, 1989. 5 fig, 9 tab, 26 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Feces, *Ivermectin, *Biodegradation, *Pesticides, Partition coefficient, Toxicity, Parasiticides.

The environmental effects and fate of ivermectin were studied as either the pure compound or in feces. Ivermectin is a novel, potent, endo-parasiticide and ecto-parasiticide with a broad spectrum of activity in animals and man. It is produced from the fermentation product avermectin B1 (atamectin) by hydrogenation of the double bond between carbons 22 and 23. Toxicities to microbes, earthworms, algae, fish and Daphnia, soil-binding parameters and degradation half-lives are determined. Ivermectin binds tightly to soils with a partition coefficient, KD, of 227 to 333, and an organic carbon binding coefficient, Koc, of 12,600 to 15,700. When stored at room temperature in feces/soil mixtures, ivermectin degraded rather slowly with long half-lives. Ivermectin degradation was also slow when exposed to outdoor, winter weather. In contrast, when exposed to the summer weather, ivermectin in soil and feces/soil mixtures degraded rapidly, with half-lives of 1 to 2 weeks. Furthermore, a half-life of 3 hours was observed when ivermectin was exposed to sunlight as a thin,dry film on glass, demonstrating rapid decomposition by sunlight. Although ivermectin is a potent agent against nematodes and arthropods, it has no antifungal, antibacterial or antiprotozoal activity, nor is it lethal to soil microorganisms. It is established, that although ivermectin has potent biological activities, it also possesses desirable environmental properties: (1) tight soil binding to prevent runoff and vertical penetration to ground water or the aquifer, (2) instability outdoors to prevent accumulation, (3) reduced toxicity when metabolized or degraded, and (4) little toxicity to nontarget organisms. Ivermectin will not accumulate in soil or water under the recommended usage patterns (0.2 mg/kg for cattle and sheep, 0.3 mg/kg for swine and seasonal administration) and does not represent a hazard to terrestrial or aquatic organisms. (Miller-PTT)
W90-00439

QUANTITATIVE STRUCTURE-TOXIC ACTIVITY RELATIONSHIP OF FATTY ACIDS AND THE SODIUM SALTS TO AQUATIC ORGANISMS.
Kao Corp., Tochigi (Japan). Research Labs.
S. Onitsuka, Y. Kasai, and K. Yoshimura.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1621-1631, 1989. 1 fig, 2 tab, 12 ref.

Descriptors: *Water pollution effects, *Fish physiology, *Toxicity, *Sodium, *Acidic water, *Fatty acids, Quantitative structure-activity relationship.

To investigate the quantitative structure-activity relationship (QSARs) for the acute toxicity of fatty acids and their sodium salts to aquatic organisms, red killifish (Oryzias latipes and gammarus (Hyale plumulosa) were studied for their sensitivity to a series of the acids and the sodium salts. Studies in the red killifish were conducted under both saline and fresh water conditions. Good QSARs of fatty acids were obtained using an octanol/water partition coefficient as the single parameter. The log LC50 of fatty acid salts with C8 t C12 carbon chain length was linearly related to a logarithm of the critical micelle concentrations (CMCs). It was found that sodium fatty acids were less toxic than the corresponding fatty acids. The soaps with very hydrophobic aliphatic tails (with more than 14 carbon atoms) became less toxic to fish. (Miller-PTT)
W90-00442

EFFECTS OF CADMIUM ON THE FEEDING BEHAVIOR OF THE FRESHWATER CLADOCERAN MOINA MACROCOPA.
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
C. K. Wong.
Chemosphere CMSHAF, Vol. 18, No. 7-8, p 1681-1687, 1989. 2 fig, 10 ref.

Descriptors: *Cladocerans, *Heavy metals, *Zooplankton, *Physiological ecology, *Water pollution effects, *Cadmium, *Feeding rates, Foods, Inhibition, Moina, Toxicity.

The effects of cadmium on the feeding behavior of Moina macrocopa is determined. Feeding behavior is important to survival and reproduction and plays an integral role in the transfer of toxins and energy through the aquatic food web. The results indicate that feeding activity was inhibited following just 24 hours of exposure to cadmium at 0.005 ppm and higher concnetrations. Decreased food intake leads to lower reproductive capacity which is consistent with a previous finding that M. macrocopa showed lower fecundity when exposed to 0.005 ppm and higher concentrations of cadmium. Experiments with M. macrocopa support the generalization that crustacean zooplankton are highly sensitive to cadmium toxicity. Results also show that gut fullness of M. macrocopa was reduced up to 50% after just 2 hours of exposure to 0.1 ppm of cadmium. This suggests that the low uptake of cadmium from a dietary source was primarily the result of decreased feeding activity. A further implication of these results is that diet may not be a major route of cadmium uptake in zooplankton species. Cadmium can affect the feeding behavior of cladocerans by way of the following: (1) cadmium may interfere with the food perception ability of the animals, (2) the metal may cause physiological damage to sensitive organs that control feeding, and (3) metal-contaminated food cells may be rejected by the animals. (Miller-PTT)
W90-00445

SELECTIVE ACCUMULATION OF CHLORINATED PARAFFINS (C12 AND C16) IN THE OLFACTORY ORGAN OF RAINBOW TROUT.
Uppsala Univ. (Sweden). Dept. of Toxicology.
For primary bibliographic entry see Field 5B.
W90-00474

CONTAMINATION OF FISH BY 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN: A SURVEY OF FISH FROM MAJOR WATERSHEDS IN THE UNTIED STATES.
Environmental Research Lab.-Duluth, MN.
D. W. Kuehl, B. C. Butterworth, A. McBride, S. Kroner, and D. Bahnick.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1997-2014, 1989. 4 tab, 6 ref.

Descriptors: *Dioxins, *Path of pollutants, *Fish, *Bioaccumulation, *Biological magnification, Pulp wastes, Surveys, TCDD, Spatial distribution, Pesticides, Fate of pollutants, Water pollution effects, Watersheds.

A survey of contamination of fish from major watersheds in the Untied States by 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) was conducted by the U.S. Environmental Protection Agency. Bottom feeding and predator fish were collected at 90 statistically selected and 30 regionally selected sites and analyzed by GC/MS. Results showed that 19% of the statistically sampled sites and 31% of the regionally selected sites were contaminated at or above a minimum level of detection varying from 0.5 to 2.0 picograms/g. Ten percent of all samples were contaminated at levels greater than 5.0 picograms/g. It was also observed that a subset of samples collected at sites near discharge from pulp/paper manufacture (N=28) had a higher frequency of TCDD contamination above 5.0 pico-

grams/g (38%). This subset of samples also contained the sample of the greatest level of TCDD contamination (85 picograms/g). (Author's abstract)
W90-00481

TRIBUTYLTIN IN THE ENVIRONMENT--SOURCES, FATE AND DETERMINATION: AN ASSESSMENT OF PRESENT STATUS AND RESEARCH NEEDS.
Station Federale de Recherches en Arboriculture, Viticulture et Horticulture de Waedenswil (Switzerland).
For primary bibliographic entry see Field 5B.
W90-00482

EVALUATION OF THE TOXICITY OF MARINE SEDIMENTS AND DREDGE SPOILS WITH THE MICROTOX BIOASSAY.
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
G. T. Ankley, R. A. Hoke, J. P. Giesy, and P. V. Winger.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 2069-2075, 1989. 1 fig, 3 tab, 17 ref.

Descriptors: *Toxicity, *Water pollution effects, *Marine sediments, *Bioassay, *Dredging, Bays, Copper sulfate, Cadmium, Aquatic bacteria, Seawater, Pollutant identification.

The Microtox bioassay was used to evaluate the toxicity of sediment and dredge spoil elutriates from several potentially-contaminated sites in Mobile and Pascagoula Bays. The Microtox assay is a bacterial luminescence bioassay based on the reduction in bioluminescence of the marine bacterium, Photobacterium phosphoreum by toxicants. Elutriates were prepared using either local seawater or distilled deionized water (osmotically adjusted with NaCl prior to testing), and Microtox assays were performed with the elutriates and three reference toxicants (copper sulfate, cadmium chloride and sodium dodecyl sulfate). There were marked differences in the toxicity of several elutriates and reference toxicants in the two different waters, with the seawater generally resulting in the same or lesser toxicity than the osmotically-adjusted distilled deionized water. When using the Microtox bioassay careful consideration should be given to the type of test water used. Based on the results with reference compounds, it was concluded that it may be possible to use the Microtox assay for establishing probable cause of observed toxicity with test solutions of different osmolarity. (Geiger-PTT)
W90-00486

EFFECTS OF A SPILL OF BUNKER OIL ON THE MARINE BIOLOGICAL COMMUNITIES IN HONG KONG.
Environmental Protection Agency, Kowloon (Hong Kong).
P. K. S. Shin.
Environment International, Vol. 14, No. 6, p 545-552, 1989. 13 fig, 31 ref.

Descriptors: *Hong Kong, *Oil spills, *Bioindicators, *Water pollution effects, *Oil pollution, Coastal waters, Phytoplankton, Macrobenthos, Rocky shore habitats, Toxicity, Limpets, Oil.

The effects of a recent bunker oil spill on the marine environment along the southern coast of Hong Kong Island were assessed through investigation of the rocky shore fauna, phytoplankton population and macrobenthic communities over a study period of 150 days. In addition, toxicity experiments were carried out in the laboratory to ascertain the toxic effect of the oil-plus-dispersant on selected test organisms. The impacts of the spill on the marine fauna were minimal with no visible reduction in species and individual numbers. Possible reasons were the small amount of oil spilled, the rapid containment and dispersion in the clean-up operations, and the less toxic effects of the heavy bunker oil. On Hong Kong shores, the limpets can be identified as indicator species to oil pollution. A quick survey of the limpet fauna on the rocky shores immediately after a spill provides an initial assessment of the impacts on the shoreline. However, faunal recovery over a long-term period may be difficult to assess in view of the lack of baseline data on most of the marine biological communities in Hong Kong waters. (Author's abstract)
W90-00515

ACCUMULATION OF ORGANOTINS IN ADULT AND SEED OYSTERS FROM SELECTED ESTUARIES PRIOR TO THE INTRODUCTION OF U.K. REGULATIONS GOVERNING THE USE OF TRIBUTYLTIN-BASED ANTI-FOULING PAINTS.
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W90-00554

UNIMPAIRED RNA SYNTHESIS IN NEURONS AND EPITHELIAL CELLS IN A FRESHWATER LEECH EXPOSED TO THE ORGANOPHOSPHATE INSECTICIDE CHLORPYRIFOS.
Calgary Univ. (Alberta). Aquatic Ecology Section.
R. N. Singhal, H. B. Sarnat, and R. W. Davies.
Science of the Total Environment STENDL, Vol. 83, No. 1-2, p 195-202, July 1, 1989. 6 fig, 29 ref.

Descriptors: *Insecticides, *Organophosphorus pesticides, *Leeches, *Water pollution effects, *Chlorpyrifos, RNA synthesis, Toxicity, Bioassay.

Chlorpyrifos (Dursban) is an organophosphate insecticide widely used mainly for control of mosquito larvae. The dominant freshwater leech Nephelopsis obscura was used as a representative aquatic invertebrate to test toxicity of chlorpyrifos on a nontarget species. RNA synthesis in neurons of the cerebral ganglion, epithelial cells of the intestine, and the tegument of small immature (50-70 mg) and large mature (300-400 mg) N. obscura was examined histochemically with acridine orange fluorochrome after exposure to chlorpyrifos in concentrations of 16, 32, 64, 128, and 144 ppb for as long as 6 weeks. The maximum environmental concentration of this insecticide in lake water, when used properly, is 4.25 ppb. There was no mortality, and no behavioral changes were observed in experimental animals, except for transient curling and cutaneous mucus secretion at the highest concentrations of chlorpyrifos. No pathological changes were observed in the intensity of RNA fluorescence or in the distribution of RNA within the cytoplasm of neurons or epithelial cells in any specimens, unlike N. obscura exposed to anoxia, hyperoxia, or salinity. Chlorpyrifos in the concentrations studied does not appear to adversely affect nucleic acid metabolism in N. obscura. (Author's abstract)
W90-00557

WATER TREATMENT SLUDGE INFLUENCE ON THE GROWTH OF SORGHUM-SUDANGRASS.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W90-00566

EFFECTS OF OZONE AND WATER STRESS, SEPARATELY AND IN COMBINATION, ON SOYBEAN YIELD.
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
For primary bibliographic entry see Field 2I.
W90-00569

ASSESSING THE TROPHIC STATUS OF LAKE MIKRI PRESPA, GREECE.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 2H.
W90-00599

GEOLOGICAL FRAMEWORK AND OBSERVED OILSEEPS OF ZAKYNTHOS ISLAND: THEIR POSSIBLE INFLUENCE ON THE POLLUTION OF THE MARINE ENVIRONMENT.
Athens Univ. (Greece). Subfaculty of Earth Sciences.
M. D. Dermitzakis, and P. Alafousou.
Thalassographica, Vol. 10, No. 2, p 7-22, 1987. 3 fig, 2 tab, 13 ref.

Descriptors: *Oil pollution, *Hydrocarbons, *Foraminifera, *Water pollution effects, *Marine environment, Marine geology, Microbiological studies, Asphalt, Frequency distribution, Plankton, Benthic fauna, Greece.

The geologic setting and the petroleum-related geological conditions of Keri Gulf and the Xygia Cape of Zakynthos island, Greece are presented. Oil in the area migrates upwards and laterally, and undersea seepages occur, as well as an asphalt spring observed in Herodotus Lake. Oil discharges are periodical and when influenced by rainfall the groundwater releases asphalt and natural gases. The value of pH is below 7 during the periods of pollution. A preliminary study was undertaken in order to evaluate the possible influence of the periodic undersea seepage of petroleum and natural gases on the pollution of the marine environment. For this the microfauna content (frequency distribution and occurrence of foraminifera) of six sea bottom stations established in the polluted region was evaluated. A high frequency of occurrence of planktonic foraminifera with a concurrent complete absence of agglutinated benthonic foraminifera has been observed. This phenomenon may be due to either the dissolution of the agglutinated foraminifera shortly after their deaths or growth prevention in a hydrocarbon-polluted marine environment. (Author's abstract)
W90-00625

EFFECTS OF ZINC/SALINITY COMBINATIONS ON ZINC REGULATION IN GAMMARUS DUEBENI FROM THE ESTUARY AND THE SEWAGE TREATMENT WORKS AT LOOE, CORNWALL.
Plymouth Polytechnic (England). Dept. of Biological Sciences.
I. Johnson, and M. B. Jones.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 69, No. 2, p 249-260, May 1989. 2 fig, 4 tab, 32 ref.

Descriptors: *Wastewater treatment, *Zinc, *Gammarus, *Heavy metals, *Amphipods, Seawater, Salt tolerance, Estuaries, Domestic wastes, Industrial wastewater, Water pollution effects, Population exposure, Tolerance, England.

At Looe, Cornwall (southwest England), engineering problems have resulted in the Sewage Treatment Works operating on saline rather than the typical freshwater sewage input. A consequence of this seawater intrusion is the replacement of the freshwater macroinvertebrate community by two species of euryhaline amphipods, particularly Gammarus duebeni, which has a wide tolerance to hypoxic exposure. It is exposed to high levels of heavy metals associated with domestic and industrial inputs. The ability of G. duebeni from the estuary and sewage treatment works to regulate total body zinc concentrations has been investigated in a range of external zinc concentrations at 10 and 30%. In both populations, irrespective of salinity, total body zinc concentrations were regulated to an external threshold of 200 micrograms per liter. At zinc concentrations above this threshold, however, salinity-dependent increases in total body zinc levels were also found to be size-dependent. Although no inter-population-based differences in zinc regulatory capacity were found, the survival of estuarine gammarids was lower than that of sewage treatment works animals at all external zinc/salinity combinations. These results, together with data on total body zinc levels in newly caught animals from the field, have been used to assess whether there is evidence for acquired zinc tolerance in the sewage treatment works population as a result of prolonged zinc exposure. (Author's abstract)
W90-00634

EFFECTS OF TRIBUTYLTIN ON DOGWHELKS (NUCELLA LAPILLUS) FROM SCOTTISH COASTAL WATERS.
Napier Coll., Edinburgh (Scotland).
S. K. Bailey, and I. M. Davies.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 69, No. 2, p 335-354, May 1989. 14 fig, 1 tab, 15 ref. Department of the Environment Contract PECD 7/8/90.

Descriptors: *Tributyltin, *Antifoulants, *Pesticides, *Scotland, *Water pollution effects, *Tin, *Heavy metals, *Population exposure, *Mollusks, Shellfish, Ecosystems, Fish farming, Boats, Sterilants, Sterilization.

Exposure of female dogwhelks, Nucella lapillus, to tributyltin (TBT) compounds induces development of certain male sexual characteristics, notably a penis and vas deferens. Relationships are described between the vas deferens stage (VDS), the vas deferens stage index (VDSI), the relative penis size index (RPSI) and total tin concentrations in dogwhelks. Comparisons are made between dogwhelk populations which have been subjected to contamination by TBT from large and small vessels, and from fish farming. Results show that TBT arising from all three sources generally has had similarly detrimental effects on dogwhelk populations. In the more contaminated areas, females exposed to TBT from fish farms had only occasionally progressed beyond VDS stage 4, while populations contaminated by vessel antifoulants could show large proportions of sterile females. There was an apparent range of RPSI values, more clearly seen in animals from boating areas, within which females at a given VDS predominated. The VDSI was the most sensitive indicator of low levels of TBT contamination, and provided information on the reproductive state of populations at all contamination levels. In populations which had been subjected to high levels of TBT both of the biological effect indices tended towards upper limits. Under these circumstances, total tin concentration became a more useful indicator variable. Tin concentrations in the soft parts of dogwhelks generally increased with increasing RPSI, whatever the source of TBT. Below an RPSI of 20%, however, concentrations of tin tended to be higher in dogwhelks from the boating area. (Author's abstract)
W90-00635

MERCURY CONCENTRATIONS IN FISH FROM CONTAMINATED AREAS IN SCOTTISH WATERS.
Marine Lab., Aberdeen (Scotland).
G. Clark, and G. Topping.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 69, No. 2, p 437-445, May 1989. 2 fig, 1 tab, 26 ref.

Descriptors: *Scotland, *Water pollution effects, *Heavy metals, *Mercury, *Fish toxins, *Ocean dumping, Waste disposal, Food chains, Industrial wastewater, Wastewater treatment, Population exposure.

The disposal of wastes to the sea is regulated internationally by the Oslo and Paris Conventions, which prohibits the direct disposal of certain substances, for example mercury compounds, unless they are present in wastes as trace constituents. Of particular concern in the case of mercury is its possible incorporation in the aquatic food chain and transfer to man via marine foodstuffs. Mercury accumulation in fish muscle is reported for three areas receiving anthropogenic inputs of mercury, including an industrial effluent in the Forth estuary, and two sewage sludge dumping operations, in the Firth of Clyde and in the North Sea off the Firth of Forth. Comparisons are made with fish from areas remote from anthropogenic inputs of mercury. There was no elevation of mercury concentrations above background in fish caught at either of the dump sites. Increased concentrations (> 0.3 milligrams per kilogram) were found in fish caught close to the industrial input. However, the mean concentrations were found to be responsible for differences in the degree of accumulation of mercury in fish flesh. (Author's abstract)
W90-00636

ROLE OF ORGANIC ACIDS IN THE ACIDIFICATION OF SURFACE WATERS IN THE EASTERN U.S.
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W90-00641

TOXICITY OF LINEAR ALKYL BENZENE SULPHONATE ON SOME AQUATIC PLANTS.
Industrial Toxicology Research Centre, Lucknow (India).
G. Chawla, V. Misra, and P. N. Viswanathan.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 41-51, January 1989. 7 fig, 9 ref.

Descriptors: *Alkylbenzene sulfonates, *Water pollution effects, *Detergents, *Plant morphology, *Aquatic plants, Species diversity, Plant growth, Growth media, Proteins, Chlorophyll, Chlorophyll a, Spectrophotometry, Electron microscopy, Plant physiology.

Synthetic detergents like linear alkylbenzene sulfonate (LAS) used in household cleaning may pose serious ecological disturbance after finding their way into rivers and ponds. Comparative studies on species variation among different species towards the same pollutants under comparable conditions have been limited. Therefore, a study of the response of some aquatic plants to the detergent was undertaken. The effect of different concentrations of LAS on various plants under laboratory conditions was studied. The plants were collected from natural habitats and acclimatized in the laboratory by growing in modified Hoagland's solution. Neutralized LAS was added to the medium to produce final concentrations of control. Plants were harvested after 48 hours of exposure. The protein content of treated and untreated plant material was estimated and chlorophylls extracted. Estimations of chlorophylls a and b were done by spectrophotometry. A dose-dependent effect on protein and on chlorophyll a and b contents leading to substantial changes were noticed in the ultrastructural features as evident from scanning electron microscopy. The severe change in surface morphology and decrease in chlorophyll and protein among aquatic plants in our studies clearly indicates that there is a definite correlation between the physiological and morphological changes due to the detergent. (Fish-PTT)
W90-00642

EFFECTS OF ACIDIC PRECIPITATION, O3, AND SOIL MG STATUS ON THROUGHFALL, SOIL, AND SEEDLING LOBLOLLY PINE NUTRIENT CONCENTRATIONS.
Tennessee Valley Authority, Oak Ridge.
G. L. Simmons, and J. M. Kelly.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 199-210, January 1989. 5 tab, 29 ref. Tennessee Valley Authority Office of Power and the Electric Power Research Institute Contract RP-2799-2.

Descriptors: *Acid rain effects, *Soil contamination, *Acidic soils, *Ozone, *Soil-water-plant relationships, *Water pollution effects, Throughfall, Seedlings, Forest hydrology, Magnesium, Pine trees, Soil water, Plant growth substances, Nutrients, Forest soils, Hydrogen ion concentration, Sand, Loam, Leaching, Growth media, Tissue analysis, Synergistic effects.

Acidic deposition can contribute to the acidification of soils, and in areas of sensitive soils can adversely affect forest growth. The individual and combined impacts of acidic precipitation, ozone, and soil magnesium (Mg) status on nutrient concentrations of throughfall, soil solution, soil, and seedling components were evaluated after one growing season. Loblolly pine seedlings were planted in a sandy loam soil having approximately 15 or 35 milligrams per kilogram of exchangeable Mg and were exposed to subambient, ambient, or twice ambient concentrations of ozone in open top chambers from May through October. Seedlings also received ambient amounts of simulated precipitation at pH 4.0 or 5.3 during this period. Concentrations of nutrients analyzed increased slightly in throughfall, but did not respond significantly to precipitation pH treatments. No increased nutrient leaching and no soil acidification were evident in soil exposed to low pH precipitation after one growing season. Ozone treatments had no significant effects on tissue nutrient concentrations. Interaction responses were very limited and do not suggest any significant synergisms. (Author's abstract)
W90-00648

APPROXIMATE DYNAMIC LAKE PHOSPHORUS BUDGET MODELS.
Noranda, Inc., Denver, CO. Environmental Services.
R. N. Havis, and D. W. Ostendorf.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 809-821, August 1989. 8 fig, 1 tab, 9 ref.

Descriptors: *Limnology, *Lakes, *Eutrophic lakes, *Phosphorus, *Cycling nutrients, *Eutrophication, *Mathematical models, Water quality, Sedimentation, Particulate matter, Detention time, Lake sediments, Phosphorus.

Impoundments or natural lakes having short hydraulic detention times may become eutrophic through anthropogenic nutrient loading episodes. Subsequent lake recovery may be influenced by nutrient transport from the lake bottom to the water column. Order-of-magnitude analysis is used to derive simple mathematical models of eutrophic lake recovery. Total phosphorus concentration (P) is used as an indicator of lake water quality. Sedimentation of particulate P from the water column and cycling from lake sediments control the rate of change of lake water P in response to a step change in external P loading. The rate of P desorption from the solid phase is more important than film transport rates across the lake bottom/water column boundary. Comparisons between exact and approximate long-term predictions of lake water total phosphorus concentration generally differ by less than 0.2%. The approximate models are convenient because they are more compact in form and appear to behave similarly to an exact analytical solution to the lake model. (Author's abstract)
W90-00662

NUTRIENTS STATUS IN A EUTROPHIC MEDITERRANEAN LAGOON.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 2L.
W90-00671

ACUTE TOXICITY OF NITROPHENOLS TO DAPHNIA MAGNA (TOXICITE AIGUE DES NITROPHENOLS VIS-A-VIS DE DAPHNIA MAGNA).
Institut Pasteur de Lyon (France).
J. Devillers.
Vie et Milieu (Life and Environment), Vol. 39, No. 2, p 87-91, June 1989, 1 tab, 32 ref. (English summary).

Descriptors: *Water pollution effects, *Toxicity, *Daphnia, *Phenols, *Nitrophenols, *Structure-activity relationships, Industrial wastes, Crustaceans, Aromatic compounds.

Toxicological effects of phenol and six nitrophenols were determined on Daphnia magna Straus, 1820. They were then compared with acute toxicological data concerning organisms occupying different trophic levels. The results obtained show that the acute toxicity of nitrophenols to this Crustacean depends on the number and position of the NO2 groups on the phenol nucleus. Therefore, the modeling of these aromatic compounds by means of Quantitative Structure-Activity Relationship (QSAR) studies could be envisaged. (Author's abstract)
W90-00672

NUTRIENT-ENHANCED GROWTH OF CLADOPHORA PROLIFERA IN HARRINGTON SOUND, BERMUDA: EUTROPHICATION OF

A CONFINED, PHOSPHORUS-LIMITED MARINE ECOSYSTEM.
Harbor Branch Oceanographic Institution, Inc., Fort Pierce, FL.
For primary bibliographic entry see Field 2L.
W90-00676

REGULATORY DETOXICATION RESPONSES IN GOBIIDAE EXPERIMENTALLY EXPOSED TO PCBS.
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
C. Fossi, C. Leonzio, and S. Focardi.
Ecotoxicology and Environmental Safety EESADV, Vol. 18, No. 1, p 11-14, August 1989. 1 fig, 1 tab, 7 ref.

Descriptors: *Water pollution effects, *Adaptation, *Biotransformation, *Goby, *Polychlorinated biphenyls, *Detoxification, Aroclors, Enzymes, Fish.

In order to investigate interspecific responses to pollutants, physiological and biochemical parameters were studied in two species of Gobiidae under both natural and experimental conditions. Gobius niger, collected in a polluted area, had higher mixed function oxidases activity and polychloroinatedbiphenyl (PCB) residues than another species, Zosterisessor ophiocephalus, collected from a relatively clean lagoon. After acclimatization to clean water and exposure to PCBs (Aroclor 1260), both species showed responses similar to those observed in the field and all biochemical parameters related to detoxification were much higher in the G. niger. This suggests that this species undergoes metabolic or genetic adaptation. (Author's abstract)
W90-00682

EFFECTS OF NATURAL EXPOSURE TO COPPER AND ZINC ON EGG SIZE AND LARVAL COPPER TOLERANCE IN WHITE SUCKER (CATOSTOMUS COMMERSONI).
Waterloo Univ. (Ontario). Dept. of Biology.
K. R. Munkittrick, and D. G. Dixon.
Ecotoxicology and Environmental Safety EESADV, Vol. 18, No. 1, p 15-26, August 1989. 1 fig, 7 tab, 21 ref.

Descriptors: *Water pollution effects, *Fish eggs, *Larvae, *Sucker, *Larval growth stage, *Copper, *Zinc, Resistance, Tolerance, Heavy metals.

Sucker eggs were collected from a metal-contaminated site where previous collections had documented a maternal yolk factor associated with an increased larval tolerance during yolk nutrition. In this study, white sucker eggs were divided into groups which were water hardened and/or incubated at the contaminated site or a reference (control) site. Incubation at the contaminated site was associated with a decreased egg size and an increased deformity rate, but had no effect on fertilization rate or larval size. Incubation in contaminated streams increased the larval whole-body metal content, and decreased the tolerance and resistance of larvae exposed to copper in laboratory bioassays. An increase in water temperature accelerated the developmental rate of the larvae, but had no detectable effect on copper tolerance. Although metals did enter the eggs during water hardening, there was no difference in egg metallothionein content, and the lack of obvious hepatic activity until several days after hatching may prevent the formation of protective proteins. The authors hypothesize that the transfer of metals to white sucker eggs in association with yolk precursors, and the subsequent mobilization of these metals during yolk utilization, can account for the observed differences in larval tolerance and growth. (Author's abstract)
W90-00683

FLUORIDE-INDUCED CHANGES IN CARBOHYDRATE METABOLISM IN THE TISSUES OF FRESH WATER CRAB BARYTELPHUSA GUERINI.
Osmania Univ., Hyderabad (India). Dept. of Zoology.
S. L. N. Reddy, N. B. R. K. Venu Gopal, A. Nagender Reddy, and J. V. Ramana Rao.
Ecotoxicology and Environmental Safety EESADV, Vol. 18, No. 1, p 59-67, August 1989. 3 tab, 50 ref.

Descriptors: *Toxicity, *Water pollution effects, *Crabs, *Sublethal effects, *Fluorides, *Carbohydrates, Metabolism, Glycogen, Lactate, Enzymes.

Exposure of fresh water field crab Barytelphusa querini to a sublethal concentration of NaF (30 ppm) caused significant alterations in the carbohydrate metabolism. In an exposure span of 15 days the crab was observed to have marked depletion in glycogen and total free sugar levels. A significant elevation in active and total glycogen phosphorylase activity was observed. The activity changes of lactate dehydrogenase reflected changes in tissue lactate levels and succinate dehydrogenase activity had a tissue specificity. (Author's abstract)
W90-00685

ACID RAIN AND ITS EFFECTS ON SEDIMENTS IN LAKES AND STREAMS.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
G. E. Likens.
Hydrobiologia HYDRB8, Vol. 176/17, p 331-348, July 3, 1989. 12 fig, 1 tab, 103 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Environmental effects, *Acid rain, *Precipitation, *Acidic water, North America, Europe, Lakes, Streams.

Wet and dry deposition of acidic substances, which are emitted to the atmosphere by human activities, have been falling on increasingly widespread areas throughout the world in recent decades. As a result, annual precipitation averages less than pH 4.5 over large areas of the Northern Temperate Zone and not infrequently individual rainstorms and cloud or fog-water events have pH values less than 3. Concurrently, thousands of lakes and streams in North America and Europe have become so acidified that they no longer support viable populations of fish and other organisms. Acid deposition may affect sediments in lakes and streams in a variety of ways. In particular, the sediment-water exchanges of metals, sulfur, nitrogen and phosphorous, microbial processes, growth of periphyton and macrophytes, and benthic invertebrates may be affected. Overall, the effects of acid deposition on lake and stream ecosystems are the result of numerous and complex biological interactions, including catchment characteristics, flow path and residence time of water and lake-basin morphometry and acid neutralization capacity of both aquatic and terrestrial (catchment) ecosystems. (Author's abstract)
W90-00722

CONCENTRATIONS AND DISTRIBUTION OF FE, ZN AND CU IN TISSUES OF THE WHITE SUCKER (CATOSTOMUS COMMERSONI) IN RELATION TO ELEVATED LEVELS OF METALS AND LOW PH.
Toronto Univ. (Ontario). Dept. of Zoology.
L. B. Young, and H. H. Harvey.
Hydrobiologia HYDRB8, Vol. 176/17, p 349-354, July 3, 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Path of pollutants, *Tissue analysis, *Toxicity, *Fish physiology, *Bioaccumulation, *Water pollution effects, *Sucker, *Iron, *Zinc, *Copper, *Heavy metals, Fate of pollutants, Sediments, Correlation analysis.

The question of whether the process of lake acidification influences the accumulation of Fe, Zn and Cu in the tissues of the white sucker (Castostomus commersoni). Concentrations of Fe, Zn and Cu were measured in the liver, kidney and muscle of the white sucker sampled from 4 acidic (pH range 4.8-5.3), 1 slightly acidic (pH = 5.8) and 3 circumneutral (pH = 6.3, 6.4) lakes located in south-central Ontario, Canada. Pearson product-moment correlation coefficients were used to determine relationships between average elemental concentrations in the 3 tissues and both sediment and water metal concentrations plus lake pH, dissolved organic carbon, and alkalinity. Despite the 1000-fold difference in H(+) concentration among the 8 study lakes, tissue concentrations of Fe, Zn and Cu did not correlate with lake pH. Average Fe, Zn and Cu tissue concentrations did not correlate with metal concentrations in lake water. Only Zn concentrations in the liver and muscle were correlated with Zn concentrations in the sediment ($r + 0.83$ and $r + 0.88$, $P < 0.05$). Iron and copper were regulated by the white sucker over a wide range of lake pH and metal concentrations in both water and sediment. In contrast, Zn tissue concentrations were correlated with sediment Zn concentrations, the latter are thought to result from Zn inputs of anthropogenic origin. (Author's abstract)
W90-00723

SEDIMENT TOXICITY TESTING IN TWO AREAS OF CONCERN OF THE LAURENTIAN GREAT LAKES: TORONTO (ONTARIO) AND TOLEDO (OHIO) HARBOURS.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
M. Munawar, and R. L. Thomas.
Hydrobiologia HYDRB8, Vol. 176/17, p 397-409, July 3, 1989. 4 fig, 6 tab, 19 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Sediment contamination, *Great Lakes, *Toxicity, *Plankton, *Bioassay, Elutriates.

The impact of elutriated sediment-associated contaminants from Toronto and Toledo Harbors on ultraplankton (5-20 microm) and microplankton/net plankton (> 20 microm) carbon assimilation rates were determined using Algal Fractionation Bioassays. All of the Toronto elutriates caused significant inhibition of ultraplankton carbon assimilation. The Toronto Site 2 elutriate caused the greatest significant inhibition (38, $p < 0.001$) with a 20% dose of standard elutriate. Similarly, all Toledo elutriates caused significant inhibition of ultraplankton productivity. Toledo Site 2 elutriate was the most toxic with the 20% elutriate dose (35%, $p < 0.001$). The treatment of elutriates with Chelex-100 resin was used to remove dissolved free metal ions which, in some samples, resulted in the recovery of 14C assimilation. This was attributed to the elimination of the toxic effects of dissolved metals removed by the Chelex treatment. Residual toxicity after the Chelex treatment was ascribed to the high PCB levels observed in the sediment samples taken from both harbors and possibly to other organic contaminants. Due to the extreme sensitivity of the technique, an EC25 is proposed as an early warning indicator for applied use by regulatory agencies. This procedure has been included amongst a battery for tests recommended by the International Joint Commission for monitoring areas of concern in the Laurentian Great Lakes. (Author's abstract)
W90-00727

TOXICITY OF METAL POLLUTED SEDIMENTS TO DAPHNIA MAGNA AND TUBIFEX TUBIFEX.
National Swedish Environment Protection Board, Uppsala (Sweden).
T. Wiederholm, and G. Dave.
Hydrobiologia HYDRB8, Vol. 176/17, p 411-417, July 3, 1989. 1 fig, 3 tab, 14 ref.

Descriptors: *Water pollution effects, *Industrial wastes, *Bioassay, *Sediment contamination, *Heavy metals, *Toxicity, *Tubificids, *Daphnia, Steel industry.

Sediments from four lakes polluted by effluents from steel industries and from two reference lakes are investigated. The sediments contained elevated concentrations of oil, Pb, Cd, Hg, Zn, Ni, and Cr in different combinations. The sediments from all four sampling stations in the Kolbacksan river system were acutely toxic to Daphnia magna as well as Tubifex tubifex. The toxicity of the polluted sediments to Daphnia was much higher than reported elsewhere (24-H LC50 was 0.5-1.5 vol%). Tubifex survived more than 3 months in the polluted sediments but growth and reproduction were inhibited. Both the Daphnia test and the Tubifex

test provided useful information on sediment toxicity and gave some ranking of lakes with respect to sediment toxicity. It is premature to recommend the use of one test for future work, based on these experiments alone. The Daphnia test is much faster and the results are obtained in a few days, whereas the Tubifex test has to be run for some months. The Tubifex test, on the other hand, gave results that could more easily be compared to field conditions in terms of infaunal community structure. (Miller-PTT)
W90-00728

MEASUREMENTS OF SEDIMENT TOXICITY OF AUTOTROPHIC AND HETEROTROPHIC PICOPLANKTON BY EPIFLUORESCENCE MICROSCOPY.
CB Research International Corp., Sidney (British Columbia).
S. R. T. Severn, M. Munawar, and C. I. Mayfield.
Hydrobiologia HYDRB8, Vol. 176/17, p 525-530, July 3, 1989. 2 fig, 33 ref.

Descriptors: *Water pollution effects, *Sediments, *Toxicity, *Plankton, *Microscopy, *Fluorescence, Sediment slurries, Epifluorescence microscopy.

Sediment toxicity from Toronto (Ontario) and Toledo (Ohio) harbors to autotrophic and heterotrophic picoplankton was evaluated simultaneously using epifluorescent microscopy. The approach is a simple, fast and effective combination of autofluorescence and fluorescence probes: 1-anilo-8-naphthalene sulfonic acid. The procedure is ideally suited for use with sediment slurries since it can differentiate fluorescent biotic material against a background of abiotic particles and detritus. The addition of sediment elutriate from Toronto harbor enhanced the number of autotrophic picoplankton. The 5% dose resulted in the largest increase. Similarly, Toledo harbor sediment elutriates stimulated the autotrophic population as indicated by the effects of the 5 and 10% dosages. The addition of toronto harbor elutriate caused an increase in the number of heterotrophic picoplankton as two fo the three concentrations. Toledo Harbor elutriate also enhanced heterotrophic growth especially at the 10% level. The experiments appear to have considerable potential for development and application of a fast and sensitive screening procedure for environmental assessment of perturbed environments. (Miller-PTT)
W90-00738

AQUATIC POLLUTION IN THE FAR EAST.
Aquatic Habitat Inst., Richmond, CA.
For primary bibliographic entry see Field 5B.
W90-00739

ENVIRONMENTAL IMPACT OF AQUACULTURE AND THE EFFECTS OF POLLUTION ON COASTAL AQUACULTURE DEVELOPMENT IN SOUTHEAST ASIA.
International Center for Living Aquatic Resources Management, Manila (Philippines).
C. T. Eng, J. N. Paw, and F. Y. Guarin.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 335-343, July 1989. 3 fig, 68 ref.

Descriptors: *Water pollution effects, *Environmental effects, *Coastal waters, *Asia, *Aquaculture, Mangroves, Organic matter, Red tide.

Coastal aquaculture, a traditional practice in Southeast Asia, is discussed. Accelerated development in the last three decades has created negative environmental impacts, such as extensive mangrove conversion to ponds, changes in hydrologic regimes in enclosed waters due to proliferation of aquaculture structures, and discharge of high levels of organic matter into coastal waters. Similarly, the increasing deterioration of coastal water quality resulting from the discharge of domestic, agricultural and industrial wastes into coastal waters has affected aquaculture production and profitability. Serious cases of oil spills cause large-scale fish kills and tainting of marine organisms, which persist for some time unless contingency measures are immediately undertaken. High levels of pesticides are lethal to fin fishes and molluscs, while lower doses which accumulate are believed to produce sublethal effects such as pathological changes in various organs. Water quality problems associated with cage farming include those due to wastes (feces and uneaten food) and nutrient discharge, reduced dissolved oxygen and high BOD, especially underneath the cages. The increased frequency of red tides in the region has posed serious threats to coastal aquaculture, especially to mollusc cultivation. The introduction of management measures to mitigate deteriorating coastal water quality and the adverse environmental impacts of aquaculture development has now become a matter of urgency to the region. (Miller-PTT)
W90-00744

WATER UPTAKE BY BLACK SPRUCE SEEDLINGS FROM ROOTING MEDIA (SOLUTION, SAND, PEAT) TREATED WITH INORGANIC AND OXALATED ALUMINUM.
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
P. A. Arp, and I. Strucel.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 57-70, March 1989. 5 fig, 2 tab, 34 ref.

Descriptors: *Acid rain effects, *Aluminum, *Plant growth, *Plant physiology, *Spruce, Complexes, Shoot growth, Weight, Solubility, Moisture uptake, Oxygen.

Experiments with solution cultures revealed that 1-year-old black spruce (Picea marinana (Mill.)) seedlings growing in nutrient solutions experienced reductions in water uptake and moist plant weight when treated with water-soluble inorganic Al at the time of rapid shoot elongation. These reductions occurred with solution concentrations for Al at $>$ or $=$ 16 mg/L. Wilting was noticed with Al $>$ or $=$ 8 mg/L. In contrast, oxalated Al treatments had no visible effects on either water uptake or moist plant weight during shoot elongation. Later, near the time of budset, neither inorganic nor oxalated Al had an effect on moist plant weight or water uptake. This suggests that black spruce seedlings may or may not be susceptible to water-soluble inorganic Al depending on the degree of Al complexation afforded by the rooting medium, and by the plant roots at different times of the growing season. Water uptake was affected by the type of rooting medium in which the seedlings grew. For example, water uptake from peat was greater than water uptake from solution. Water uptake from sand was intermediate. Water uptake from solution-only cultures was probably affected by restricted O2 supply. (Author's abstract)
W90-00803

COMPARISON OF THE EFFECTS OF SEDIMENTS AND STANDARD ELUTRIATES ON PHOSPHORUS KINETICS IN LAKEWATER.
Scarborough Coll., Westhill (Ontario). Life Sciences Div.
C. Nalewajko, C. Ewing, and C. Murdoch.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 119-134, March 1989. 7 fig, 3 tab, 34 ref.

Descriptors: *Phosphorus, *Phosphates, *Nutrients, *Sediment-water interfaces, *Lake Ontario, *Niagara River, Heavy metals, Algae, Elutriates, Lakes.

Sediments from a mid-Lake Ontario station and from the Western Basin close to the Niagara River contained elevated concentration of several metals but were not grossly polluted, and did not differ much in metal concentrations. However, sediments and sediment elutriates differed in metal concentrations and the relative abundance of metals. The pH in elutriates was also higher than in sediments. Phosphate concentrations in elutriates were 2 orders of magnitude higher than in lakewater. Elutriates appeared to act as sources of P to lakewater microorganisms and to algae in cultures. In contrast, sediments competed for phosphate with P-sufficient algae. In lakewater and in P-deficient algal cultures, P32-PO4 dynamics either did not change or were erratic when sediments were added which suggests that initial consumption of phosphate by sediments was followed by release. It was concluded that, in elutriates, phosphate availability and metal toxicity to microorganisms are too different from that of the solid phase to allow the use of elutriates to model sediments in studies of the effects of dredging, or dredged sediment disposal on phosphate uptake in microorganisms. (Author's abstract)
W90-00805

COPPER TOXICITY AND CHEMISTRY IN THE ENVIRONMENT: A REVIEW.
Guelph Univ. (Ontario). Dept. of Environmental Biology.
C. A. Flemming, and J. T. Trevors.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 143-158, March 1989. 97 ref.

Descriptors: *Water pollution effects, *Copper, *Literature review, *Toxicity, Industrial wastes, Agriculture, Soil types, Sediments, Speciation, Accumulation, Chemical properties.

Copper compounds have been widely used in industrial processes and agriculture. As a result, elevated Cu concentrations can be found in certain areas of the biosphere. To better understand the toxicity of Cu to organisms it is necessary to understand the mechanism by which Cu influences biological and chemical processes in the environment. This review examines Cu toxicity, microbial resistance mechanisms, and factors influencing Cu speciation and toxicity in the environment. Findings indicate that the concentrations of Cu reported to be toxic in the natural environments such as soils, sediments and waters, vary considerably. Copper toxicity is dependent upon its availability as well as physico-chemical characteristics of the particular environment, that influence metal speciation. Although a great deal of research has been conducted on Cu accumulation, Cu toxicity, and chemistry, there is still a paucity of knowledge in certain areas. The exact mechanism(s) of Cu-resistance are not well understood in microorganisms. In addition, studies on Cu chemistry in the environment will provide forthcoming knowledge on Cu toxicity in complex environments like soil, sediment and water, where free Cu concentration may be relatively low, even though the total Cu concentration may be extremely high. (Author's abstract)
W90-00806

INFLUENCE OF O3, RAINFALL ACIDITY, AND SOIL MG STATUS ON GROWTH AND ECTOMYCORRHIZAL COLONIZATION OF LOBLOLLY PINE ROOTS.
Tennessee Valley Authority, Oak Ridge.
G. L. Simmons, and J. M. Kelly.
Water, Air and Soil Pollution WAPLAC, Vol. 44, No. 1-2, p 159-171, March 1989. 2 fig, 6 tab, 32 ref.
TVA Office of Power and the Electric Power Research Institute Contract RP-2799-2.

Descriptors: *Ozone, *Acid rain, *Magnesium, *Pine trees, *Soil fungi, Loblolly pine seedlings, Biomass, Roots, Hydrogen ion concentration, Infection, Mycorrhizae.

Root biomass, length, and branching frequency, and number and type of mycorrhizal shortroots were determined for loblolly pine seedlings grown at two levels of soil Mg and exposed to chronic levels of O3 and simulated acidic rainfall. Seedlings were planted in a sandy loam soil having approximately 15 or 35 mg/kg Mg and were exposed to subambient, ambient, or twice ambient concentrations of O3 in open top chambers from May through October. Seedlings also received ambient amounts of simulated rainfall at pH 3.8 or 5.2. Root biomass, length, and branching frequency were not significantly affected by O3, rainfall acidity, or soil Mg treatments. Seedlings grown in the subambient O3 treatment had a greater number of short roots infected with mycorrhizae than seedlings grown in ambient or twice ambient O3 treatments, but trends were not statistically significant. Increasing rainfall acidity and soil Mg concentration resulted in a significantly ($P = 0.07$) greater number of mycorrhizal short roots, due primarily to an increased occurrence of one corraloid mycorrhizal

type. Results suggest that mycorrhizal fungi differ in their response to O3, rainfall acidity, and soil Mg status, and suggest that mycorrhizal infection is more sensitive than seedling root growth to O3, acidic rainfall, and soil Mg status. (Author's abstract)
W90-00807

CHRONIC EFFECTS OF LOW PH AND ELEVATED ALUMINUM ON SURVIVAL, MATURATION, SPAWNING AND EMBRYO-LARVAL DEVELOPMENT OF THE FATHEAD MINNOW IN SOFT WATER.
Environmental Research Lab.-Duluth, MN.
J. H. McCormick, K. M. Jensen, and L. E. Anderson.
Water, Air and Soil Pollution WAPLAC, Vol. 43, No. 3/4, p 293-307, February 1989, 3 fig, 2 tab, 65 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Minnow, *Toxicity, *Fish, *Aluminum, *Hydrogen ion concentration, Embryonic growth stage, Spawning.

Fathead minnows (Pimephales promelas) were exposed to a range of pH and Al concentrations in soft water (8 mg Ca/L) to determine effect levels at various life stages. The tested pH levels ranged from 8.0 through 5.2 and inorganic monomeric Al from 15 through 60 micrograms/L. Reproductive processes including spawning, embryogenesis and early larval survival were more sensitive to acid stress than were juvenile growth and survival. Juvenile survival was significantly reduced at pH 5.2 + 60 micrograms Al/L ($P < 0.05$). Spawning success was reduced at pH 6.0 and 5.5 ($P < 0.10$) and failed completely at pH 5.2, regardless of Al concentration. An apparent beneficial effect of added Al was observed during spawning at pH 7.5 + 35 micrograms Al/L, but this effect was not significantly greater than at pH 7.5 + 15 micrograms Al/L. A significant ($P < 0.05$) decrease in larval survival occurred at pH 6.0 + 15 micrograms Al/L and lower compared to the survival at pH 7.5 + 15 micrograms Al/L. Aluminum at 30 micrograms/L provided protection resulting in short term increased embryo-larval survival at pH 5.5. The effect of parental exposure on progeny survival was assessed by an interchange of embryos from the spawning treatment to all tested exposure conditions. When reared at pH 8.0 + 15 micrograms Al/L through 6.0 + 15 micrograms Al/L or at pH 5.5 + 30 micrograms Al/L, parental exposure did not significantly influence progeny survival. However, survival was significantly reduced among progeny from brood fish reared at pH 5.5. + 15 micrograms al/L as compared to those spawned at pH 6.0 + 15 micrograms Al/L and above, or at pH 5.5 + 30 micrograms Al/L ($P < 0.05$). Juvenile or 14 d larval growth effects were not detected under any exposure condition ($P > 0.05$). Ultimately, fathead minnow young-of-the-year recruitment and production potential can be expected to diminish when environmental pH falls to 6.0, and to fail completely at 5.5. and lower. (Author's abstract)
W90-00813

ACIDIFICATION AND OTTER (LUTRA LUTRA) DISTRIBUTION IN SCOTLAND.
Essex Univ., Colchester (England). Dept. of Biology.
C. F. Mason, and S. M. Macdonald.
Water, Air and Soil Pollution WAPLAC, Vol 43, No. 3/4, p 365-374, February 1989, 1 fig, 5 tab, 24 ref.

Descriptors: *Acidification, *Acid rain effects, *Water pollution effects, *Acid streams, *Otters, *Hydrogen ion concentration, *Aluminum, *Distribution patterns, Wildlife habitats, Scotland.

The influence of acidification on otters (Lutra lutra) was assessed in three regions of Scotland. A total of 72 stretches of 1000 m of riverbank were searched for all signs of otters on three occasions. Water chemistry was determined and habitat was assessed for its suitability to otters. A further series of water samples were collected after a period of very heavy rain in midwinter; conductivity and pH were measured and total Al was determined on a filtered, acidified sample. Otters were recorded at all sites. There were highly significant correlations between use by otters of stretches (measured in terms of marking intensity) and both pH and conductivity, with pH accounting for the greatest proportion of variation in otter signs in a stepwise multiple regression. The relation between otter signs and water quality was greatest in Galloway, the region with significantly more acid waters. There were significantly fewer signs of otters in stretches with minimum pH thought to be detrimental to fish populations for two regions, Galloway and Sutherland. (Author's abstract)
W90-00816

COMPARATIVE STUDY OF WATER MINERALIZATION AND NUTRIENT STATUS IN THE MAIN WATER COURSES OF BISCAY (BASQUE COUNTRY).
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
For primary bibliographic entry see Field 5B.
W90-00826

SHORT TERM EFFECTS OF NUTRIENT ENRICHMENT ON THE QUALITY OF IRRIGATION WATER.
Nessin Water Quality Central Lab., Nazareth (Israel).
B. Teltsch, I. Ben-Harim, J. Eren, and H. Leventer.
Water Research WATRAG, Vol 23, No. 6, p 719-724, June 1989. 5 fig, 2 tab, 22 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Water pollution effects, *Water quality, *Enrichment, *Nutrients, *Irrigation water, *Clogging, Water reuse, Filtration.

The input of reclaimed effluents to an operational irrigation reservoir in the form of sporadic pulses produced changes in the behavior of the reservoir and in the quality of its outflow. A clogging event of strainers, that affected drip irrigation network, was connected to high concentrations of algae and zooplankton. Growth of these depends not only on nutrients supplied by effluents, but also on independent parameters such as depth of the reservoir. Application of a filterability test enabled estimation of the filterability capacity of the water and suggested a complicated clogging-effluent relationship. (Author's abstract)
W90-00828

ADSORPTION AND RELEASE OF PHOSPHATE FROM SEDIMENTS OF A RIVER RECEIVING SEWAGE EFFLUENT.
Southern Water Authority, Chatham (England). Kent Div.
For primary bibliographic entry see Field 5B.
W90-00829

ANALYSIS OF MALATHION AND ITS BREAKDOWN PRODUCTS IN AQUARIA CONTAINING GOLDEN SHINERS (N. CHRYSOLEUCAS).
University of Southern Maine, Portland. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-00855

PREDICTING THE FATE AND EFFECTS OF CHLORINATED HYDROCARBONS IN A COASTAL MARINE SYSTEM--SOUTH-EAST INDIAN OCEAN.
Port Elizabeth Univ. (South Africa). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W90-00867

PREDICTION OF NUISANCE PERIPHYTIC BIOMASS: A MANAGEMENT APPROACH.
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, R. R. Horner, and C. R. Patmont.
Water Research WATRAG, Vol. 23, No. 4, p 401-405, April 1989. 1 fig, 1 tab, 27 ref. NSF Grant No. CEE-83-04731.

Descriptors: *Eutrophication, *Water pollution effects, *Phosphorus, *Nuisance algae, *Model studies, *Spokane River, *Aquatic weed control, Epiphytes, Running waters, Streams, Chlorophyll a, Growth kinetics model, Biomass, Temperature, Limiting nutrients, Wastewater disposal.

Model predictions of periphyton biomass, as a function of ambient soluble reactive phosphorus (SRP) concentration, were compared against observed biomass accrual on natural and artificial substrates in the Spokane River, Washington. A range in biomass was predicted based on uncertainties due to temperature, velocity, accumulation period and an empirical growth constant. Only 8 of 47 observed biomass values exceed the lowest biomass predictions, which support the contention that the model represents the maximum potential biomass. Using the SRP concentration that would produce a threshold nuisance biomass (150-200 mg chl a/sq m), an approach is proposed for controlling the stream distance for which periphytic biomass exceeds the nuisance level. For the Spokane River, critical distance with biomass exceeding 200 mg chl a/sq m may exceed 10 km unless SRP is held below 10 micrograms/L. (Author's abstract)
W90-00899

FLOW CYTOMETRY FOR ALGAL STUDIES.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 7B.
W90-00903

RESULTS OF THE HARMFUL EFFECTS OF SELECTED WATER POLLUTANTS (ANILINES, PHENOLS, ALIPHATIC COMPOUNDS) TO DAPHNIA MAGNA.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
R. Kuhn, M. Pattard, K.-D. Pernak, and A. Winter.
Water Research WATRAG, Vol. 23, No. 4, p 495-499, April 1989. 4 tab, 3 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Toxicity, *Testing procedures, *Daphnia, *Organic compounds, Phenols, Dyes, Hydrocarbons.

Using the acute Daphnia test (according to DIN 38412, Part II, Daphnia short-time test, German Institute of Standardization, 1982) the EC50, EC0 and EC100 after 24 and 48 h test time were calculated or determined for 70 substances--phenols, anilines and aliphatic compounds. The results of the tests are given in three tables according to substance group. Evaluation showed that the toxicity of the substances (particularly in the case of anilines) may be higher or even substantially greater when the test period is extended from 24 to 48 h. Therefore, the extension of the test period by 24 hours should always be recommended. (Author's abstract)
W90-00910

RESULTS OF THE HARMFUL EFFECTS OF WATER POLLUTANTS TO DAPHNIA MAGNA IN THE 21 DAY REPRODUCTION TEST.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
R. Kuhn, M. Pattard, K.-D. Pernak, and A. Winter.
Water Research WATRAG, Vol. 23, No. 4, p 501-510, April 1989. fig, tab, ref.

Descriptors: *Bioindicators, *Toxicity, *Daphnia, *Water pollution effects, *Testing procedures, Reproduction, *Organic compounds, Cadmium, *Metals, Chlorinated hydrocarbons, Esters, Alcohols, Hydrocarbons, Phenols.

Investigations were carried out to determine the 'no observed effect concentration' (NOEC) of 73 environmentally relevant substances in the 21 day Daphnia reproduction test. The test was conducted

in line with the provisional procedure proposed by the West German Federal Environmental Agency (Unweltbundesamt) (as of 1 January 1984). Daphnia magna Straus was used as the test organism. Evaluation parameters for fixing the NOEC were the mortality of the parent animals, the reproduction rate and the appearance of the first offspring during the test period. The concentrations of substances in the test preparations were chemically quantified. The NOEC values obtained for ethyl parathion, bis(tri-n-butyltin)oxide and the active ion Cd (II) were in the concentration range 1 ng/L to 1 microg/L for 13 tested substances in the range 1 microgram/L to <0.1 mg/L and for 23 substances in the range 0.1 to <1 mg/L. In further evaluation of the results, it could be calculated that the substance concentration of the NOEC for three substances was more than 3 logs, in the case of 13 substances more than 2 logs, for 10 substances 50-90 times, for 24 substances 10-40 times and for 14 substances 5-9 times lower than the 24 h EC50 of the corresponding substance. (Author's abstract)
W90-00911

CALCIUM BUDGETS FOR CATCHMENTS AS INTERPRETED BY STRONTIUM ISOTOPES.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 2K.
W90-00918

STORM PERIOD HYDROCHEMICAL RESPONSE IN AN UNFORESTED SCOTTISH CATCHMENT.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W90-00937

5D. Waste Treatment Processes

MANUAL FOR SEWAGE SLUDGE APPLICATION TO CROPLANDS AND ORCHARDS.
Battelle Environmental Program Office, Washington, DC.
For primary bibliographic entry see Field 5E.
W90-00086

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
R. L. Jolley, and J. D. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011840. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-870524--3, (1987). 28p, 1 fig, 1 tab, 55 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Literature review, *Chemical analysis, *Research priorities, *Wastewater treatment, *Water treatment, *Chlorination, Chemical treatment, Public health, Industrial wastewater, Model studies, Drinking water, Pulp and paper industry.

This brief literature review summarizes the principal research that was published in the interval between the fifth and sixth water chlorination conferences (1984-1987) and that is not specifically presented in this volume. The review is divided into major groupings and proceeds from that area of chemistry that is a fundamental basis for most science (i.e., analytical chemistry) and progresses to areas of human health and environmental concerns: analytical chemistry, artifact problems, model compounds, humic acids, freshwater, seawater and cooling water, drinking water, wastewater, effluents from pulp and paper industry, and environmental samples. (Lantz-PTT)
W90-00092

DETERMINATION AND ENHANCEMENT OF ANAEROBIC DEHALOGENATION: DEGRADATION OF CHLORINATED ORGANICS IN AQUEOUS SYSTEMS.
Battelle Columbus Div., OH. Cellular and Molecular Biology Section.
D. T. Palmer, T. G. Linkfield, J. B. Robinson, B. R. Sharak Genthner, and G. E. Pierce.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-110282. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/054, September 1988. 49p, 7 fig, 7 tab, 48 ref. EPA Contract CR811120-02-4.

Descriptors: *Water pollution treatment, *Biodegradation, *Dehalogenation, *Anaerobic bacteria, *Organic compounds, *Wastewater treatment, Anaerobic digestion, Chlorobenzoates, Chromatography, Microbiological studies.

Anaerobic degradation has the potential of providing efficient processes for destroying or detoxifying many environmental pollutants. Much interest is currently focused on the area of anaerobic degradation of halogenated organic compounds because of the toxicity of many of these compounds. Enrichments were made using secondary anaerobic digestor sludge (from Columbus, OH) as an inoculum. Anaerobic enrichments containing either r3-or 4-chlorobenzoate. Degradation of 4-chlorobenzoate was not observed. Degradation of 4-chlorobenzoate (3CB), as measured by High Pressure Liquid Chromatography (HPLC), was observed after 10-23 weeks, first in the nitrate enrichment and later in the methogenic enrichments. Genetic studies were conducted using a pure culture of strain DCB-1, the dehalogenating microorganism from Tiedje's 3CB degrading consortium. Strain DCB-1 was examined for plasmid DNA using two different methods, alkaline lysis and salt-cleared lysis, but no plasmids were found. Therefore, it was presumed that the dehalogenase activity was chromasomally encoded. Genomic DNA was extracted and purified using a modified version of the procedures previously used with anaerobes. A partial library was generated by cloning large DNA fragments into the cosmid pHC79 and small fragments into the plasmid pUCB. To aid in isolating recombinants with dehalogenase activity, a rapid dehalogenase assay, based on the reaction which occurs between iodine and starch, was developed. (Lantz-PTT)
W90-00134

ONSITE WASTEWATER DISPOSAL.
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
R. J. Perkins.
Lewis Publishers, Chelsea, MI. 1989. 251p.

Descriptors: *On-site waste disposal, *Wastewater disposal, *Wastewater treatment, Land disposal, Case studies, Septic tanks, Cesspools, Evapotranspiration, Composting, Disinfection, Liquid wastes, Site selection, Sanitary engineering.

The technology of onsite liquid waste disposal has rapidly advanced during the last decade. In addition to the rediscovery of very old and very satisfactory methods of disposal, new methods have been developed for application on difficult sites (drain fields, deep absorption trenches, seepage pits, cesspools, absorption beds, leaching chambers, sand mounds, land application, evapotranspiration, holding tanks, composting, toilets, and disinfection). These new methods have been in use long enough that some performance data are available. It is now possible to present design criteria, construction methods, and maintenance requirements, as well as to identify potential problems for each of these systems. The designs presented in Part II of this book are tested and proven, are addressed by many states in their regulations, and are suitable for use both by persons living an isolated existence far removed from neighbors and by developers planning waste disposal systems for subdivisions. However, each site has its own climatic and physical characteristics, each installer has his own techniques, and each user has his own habits. The purpose of this book is to provide information sufficient to allow a homeowner, potential homeowner, contractor, septic system installer, or consulting engineer to evaluate the future site of a liquid waste disposal system, to identify any potential problems, and to select and design a system that will provide adequate protection at minimal cost. (Lantz-PTT)
W90-00175

WATER AND WASTEWATER FINANCE AND PRICING.
Young (Arthur) and Co., Charlotte, NC.
G. A. Raftelis.
Lewis Publishers, Chelsea, MI. 1989. 220p.

Descriptors: *Financing, *Water treatment, *Pricing, *Economic aspects, *Wastewater treatment, Utilities, Costs, Capital costs, Capital sewage rate, Water rates.

This book is a comprehensive guide to finance and pricing for water and wastewater treatment. Organized in two main sections--(1) financing water and wastewater services; (2) water and wastewater pricing--this book covers everything from privatization and setting rate structures to long-term and short-term financing. Traditional and innovative financing methods and pricing structures are also provided. This technical guide and management tool--using examples throughout--shows the complete picture of capital financing and how to keep a utility operating on an environmentally feasible and economically sound basis. Chapter headings include: (1) capital and financial planning for water and wastewater utilities; (2) bonds, short-term financing, and credit enhancements; (3) capital recovery charges; (4) privatization; (5) selecting the appropriate capital and financial plan; (6) water and wastewater pricing process; (7) identification of revenue requirements; (8) determination of cost of service; (9) designing a water and wastewater rate structure; and (10) comparing water and wastewater rates among utilities. (Lantz-PTT)
W90-00176

GASSING OF BIOSUSPENSIONS IN BUBBLE COLUMN AND LOOP REACTORS (BEGASUNG VON BLOSUSPENSIONEN IN BLASENSAEUIEN UND SCHIAUFENREAKTOREN).
Stuttgart Univ. (Germany, F.R.). Fakultaet 13 - Verfahrenstechnik.
G. Mueller.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81426/GAR. Price codes: E11 in paper copy, A01 in microfiche. April 1986. 133p, 57 fig, 1 tab, 82 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Aeration, Mathematical models, Gas velocity, Bubble size, Bubble distribution.

In the aeration tanks of biological wastewater purification plants, oxygen is consumed in the aerobic metabolism of microorganisms. As a rule, oxygen is supplied by gassing the sludge/water suspension with air. The parameters determining the gas/liquid transport, i.e. the void gas velocity, bubble size and bubble distribution, were determined using the specific mass transfer coefficient k sub L a/w sub G. The coefficient is determined, for the most part, by the aerator characteristics and by the coalescence behavior of the water/sludge suspension. The influence of these parameters on the optimum reactor height under energy aspects is shown using mathematical models. The findings suggest that the optimum reactor height is not constant but depends on the aerator parameters, the water coalescence characteristics, and the remixing of the liquid phase. (Author's abstract)
W90-00190

OPERATION OF A TOWN DRAINAGE SYSTEM BY OUTFLOW CONTROL ON A RAIN RESERVOIR (BEWIRTSCHAFTUNG EINES STADTISCHEN ENTWASSERUNGSSYSTEMS DURCH ABFLUBSTEUERUNG AN EINEM REGENRUCKHALTEBECKEN).
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wasserguetewirtschaft und Gesundheitsingenieurwesen.
For primary bibliographic entry see Field 4A.
W90-00191

HAZARDOUS WASTE AND WASTEWATER CHARACTERIZATION SURVEY, COLUMBUS AFB MS.

Air Force Occupational and Environmental Health Lab., Brooks AFB, TX. Human Systems Div.
F. E. Slavich, R. A. Tetla, and A. T. Zimmer.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199 232. Price codes: A04 in paper copy, A01 in microfiche. USAFOEHL Report No. 88-076EQ0040FHH, June 1988. Final Report. 91p, 5 fig, 6 tab, 11 ref, 2 append.

Descriptors: *Hazardous materials, *Waste disposal, *Military installations, *Wastewater treatment, Solvents, Oil wastes, Surveys, Water pollution sources, Chromium, Cadmium, Heavy metals, Underground waste disposal, Storage tanks.

A wastewater characterization and hazardous waste survey was concluded at Columbus AFB to address problems concerning the discharge of industrial wastes to the sanitary sewer system and subsequently to the base wastewater treatment plant. The treatment plant is authorized to discharge to the Tombigbee waterway under the state of Mississippi National Pollutant Discharge Elimination System (NPDES) Permit Program. The results of the hazardous waste survey indicate that shop wastes are being properly contained, labeled and transported. Waste oils, solvents and fuels are sent to underground storage tanks that have not been properly leak tested. Most of the oil/water sludge waste is being pumped into an underground holding tank, for disposal by the contractor every three years. This practice is unacceptable. The results of the wastewater survey indicate that both the parts Cleaning Shop, and the Corrosion Control Shop, are discharging substantial amounts of priority pollutants into the sanitary system which are still being found in the treatment plant effluent. High levels of chromium and cadmium were also discharging to the sanitary sewer. The lenient parameters of the State of Mississippi NPDES permit do not cover the priority pollutants that discharge directly into the Tombigbee waterway. (Lantz-PTT)
W90-00240

APPLICATION OF A HAZARDOUS WASTE MANAGEMENT MODEL FOR SELECTED INDUSTRIES.
Argonne National Lab., IL. Energy and Environmental Systems Div.
R. W. Peters, C. A. Wentz, S. Y. Chiu, L. E. Martino, and L. J. Habegger.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-012066. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8806168--1, (1988). 21p, 5 fig, 2 tab, 8 ref. DOE Contract W-31-109-ENG-38.

Descriptors: *Hazardous materials, *Hazardous wastes, *Wastewater treatment, *Waste management, *Model studies, Recycling, Waste recovery, Lime, Ion exchange, Reverse osmosis, Electrodialysis, Costs, Economic aspects.

Rather than modifying or adding other end-of-the-pipe treatment technologies to cope with the ever more stringent discharge limits being placed on industries, the recent development of waste minimization-waste reduction practices has furnished a focal point to address pollution prevention or minimization. Based on mass balance information, waste minimization involves various practices, including material substitution; process technology improvement; equipment improvement; and recycle, reuse, and recovery. An essential element for any successful waste minimization involves the development of a waste tracking program. The tracking program assists in the evaluation of various waste minimization alternatives being considered. Using data provided from several plating shops, various treatment technologies were evaluated with regard to their effect on the quantities of waste requiring disposal. The treatment processes considered include lime softening, cation exchange, reverse osmosis, and electrodialysis. Lime softening appears to be most cost-effective treatment of those technologies considered. Significant cost savings occur as a result of minimizing the water content in the waste requiring disposal. (Author's abstract)
W90-00241

DEMONSTRATION AND EVALUATION OF THE CAPTOR PROCESS FOR SEWAGE TREATMENT.
Water Research Centre, Stevenage (England).
P. F. Cooper.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-118665. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/060, October 1988. 112 p, 21 fig, 34 tab, 12 ref, append. EPA Contract CR-810911.

Descriptors: *Wastewater treatment, *Activated sludge process, Pilot plants, CAPTOR, Biological wastewater treatment, Biomass, Activated sludge, Economic aspects, Suspended solids, Economic evaluation, Performance evaluation.

The Water Research Centre (WRC) and Severn-Trent Water Authority conducted a full-scale evaluation of the process for uprating the activated sludge plant and Freehold Water Reclamation Works (near Stourbridge in the West Midlands of England) achieve year-round nitrification. The process suffered from several major operation problems. This report describes how these problems were tackled by research and development work carried out on a pilot-scale work at the WRC's Stevenage Laboratory and a demonstration plant at Freehold, before implementation on the full-scale plant at Freehold. The first problem was that the CAPTOR particles would not mix with the liquor but remained floating at the liquid surface. This problem was successfully overcome by modifying the system to a spiral-roll arrangement. The second problem was that the CAPTOR particle cleaners were not reliable enough. The Mark II particle cleaners made by Simon-Hartley were a considerable improvement upon the Mark I cleaner but still did not reach the level of reliability needed. The third problem was that of mal-distribution of the pads in the tank. This was overcome by modification to the liquid flow pattern in the system. The final practical problem was that the performance of the system was very adversely affected by the very high level of suspended solids in the CAPTOR sewage effluent. The pilot scale work tried several ways of reducing this problem but did not find a satisfactory answer. The work showed that it was possible to raise the biomass concentration in the CAPTOR unit to 6000-8000 mg/L but it also showed that the respiration rate of the biomass in the pads is less than the same biomass if freely suspended and less than normal activated sludge. Several variants of the CAPTOR process were tried out in the pilot and full-scale systems. An economic evaluation of the CAPTOR varients was carried out. If the problem of the high suspended solids concentration in the CAPTOR state effluent could be overcome, the process would look much more attractive for uprating existing activated sludge plants to achieve nitrification but at the present time it is doubtful if the process is economical. (Lantz-PTT)
W90-00254

INVESTIGATIONS ON TREATMENT OF WASTEWATER AND SLUDGE, NITRIFICATION AND REDUCTION OF PHOSPHATES IN LIME PRE-PRECIPITATION WITH SUBSEQUENT AEROBIC STABILIZATION (UNTERSUCHUNGEN ZUR ABWASSER-UND SCHLAMM-HYGIENISIERUNG, NITRIFIKATION UND PHOSPHATVERMINDERUNG BEI DER KALKVORFALLUNG MIT NACHFOLGENDER AEROBER STABILISIERUNG).
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Tiermedizin und Tierhygiene.
S. Ostertag.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80036/GAR. Price codes: E07 in paper copy, A01 in microfiche. 1986. 157p, 24 fig, 44 tab, 149 ref. English summary.

Descriptors: *Wastewater treatment, *Disinfection, *Lime, *Salmonella, Primary sludge, Feces, Ventilation.

In the context of wastewater ans sludge research, process and hygiene investigations were carried out. Comparative hygiene investigations were done with the use of lime or lime/Fe (2+) in precipitation and simultaneous precipitation. Large scale experiments were concerned with the disinfection effect of burnt lime on dehydrated sewage sludge. Investigations were also made with lime on the half technical scale, and the primary, excess and feces sludges from the different phases of the experiment were examined. The effect of lime on test salmonella in crude water and in primary sludge was determined for the possibility of infectious disease. In pre-precipitation with lime up to a pH value of 11.0, there was no elimination of the salmonella from the crude wastewater. Concentration experiments with lime showed that ventilation supported the disinfectant effect of the lime doses. However, very small quantities of 339 kg CaO/tonne of TS (burnt lime) were sufficient to kill the salmonella. (Author's abstract)
W90-00258

DEVELOPMENT AND INVESTIGATION OF A PROCESS FOR THE ELECTROCHEMICAL TREATMENT OF WASTEWATER (ENTWICKLUNG UND UNTERSUCHUNG EINES VERFAHRENS ZUR ELEKTROCHEMISCHEN AUFBEREITUNG VON ABWASSER).
Technische Univ. Muenchen, Garching (Germany, F.R.). Anorganische-Chemisches Inst.
D. Wabner.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-82029/GAR. E09 in paper copy, A01 in microfiche. Contract 02-WA-283, 1986. 98p, 39 fig, 18 tab, 51 ref. English summary.

Descriptors: *Wastewater treatment, *Organic wastes, *Electrochemistry, Electrolytic oxidation, Lead-dioxide-anodes, Ozone, Phenols, Toluenesulfoacid, Lignines, Pyridine, Papermill wastes, Pharmaceutical wastes, Polishing.

An electrochemical process is presented for the oxidative degradation of organic substances in water. This electrolytic oxidation with lead-dioxide-anodes uses an undivided type of cell. Hydroxyl radicals, which are evolved in high concentrations during water electrolysis as a primary step of ozone, are the oxidizing agent. The lifetime of the active layer of electrodes is tested. New coatings are developed as well as a new method of pretreatment of the titanium carrier. Investigations of degradation are carried out with phenols, chlorine phenols, p-toluenesulfoacid, lignine like compounds (chlorolignines, ligninesulfonate), lead organyles, pyridine, laundry wastewater, pool water, papermill wastewater, and pharmaceutical wastewater. The degradation process is combined as well with the conventional activated sludge. 'Electrolytic oxidation' is suggested for degradation of process wastewaters and for use as a polishing step after conventional degradation methods. The elimination of lead compounds should be developed in the future. Also the high disinfection power of the electrolytic oxidation should be investigated further. Out of this a method a decentral treatment of water in cases of disaster could be developed. (Author's abstract)
W90-00268

DEWATERING BEHAVIOUR OF SEWAGE SLUDGE WITH INORGANIC AND MACROMOLECULAR MEANS OF FLOCCULATION (ENTWAESSERUNGSVERHALTEN EINES FAULSCHLAMMES MIT ANORGANISCHEN UND MAKROMOLEKULAREN).
Technische Univ. Braunschweig (Germany, F.R.).
M. Prescher.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-81282/GAR. Price codes: E07 in paper copy, A01 in microfiche. 1987. 149p, 64 fig, 20 tab, 95 ref. English summary.

Descriptors: *Wastewater treatment, *Dewatering, *Sludge drying, *Sludge, Metal salts, Organic macromolecules, Flocculation, Ash, Lime, Hydroxide.

A community sewage sludge after conditioning with inorganic hydrolyzing metal salts and organic macro-molecules soluble in water resulted in the original solid content increasing from 3% by weight to 35% by weight when the sludge was dewatered by computer controlled pressure filtration. It was found that although destabilization with FeCl3 leads to satisfactory separation of sludge water from the solid particles, the concentration by flocculation with its essential sludge additives for dewatering (such as ash and lime) contradict the required result of reducing the volume. However, the use of non-ionic and anionic polymers for flocculation gives good dewatering results but also has the same disadvantage. Cationic polyacrylic amide derivatives, which supplied the best dewatering results at minimum concentrations, proved best. A distinctly higher mechanical stability was found in contrast to inorganic hydroxide flocculants. (Author's abstract)
W90-00272

POSSIBILITIES OF PRODUCING DIGESTER GAS IN MUNICIPAL SEWAGE TREATMENT (MOEGLICHKEITEN DER FAULGASPRODUKTION IN KOMMUNALEN KLAERANLAGEN).
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung.
P. Kunz, and D. Toussaint.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-81912/GAR. Price codes: E07 in paper copy, A01 in microfiche. July 1986. 39p, 16 fig, 6 tab. English summary.

Descriptors: *Wastewater treatment, *Sludge digestion, *Power plants, *Digester gas, Modular cogeneration plants.

Different steps are proposed and practically examined which will allow efficient operation of modular cogeneration power plants in smaller sewage treatment plants. This requires adaptation of the process of sewage and sludge treatment to the demands and possibilities of modular cogeneration plants, and control of digester gas yield in such a way as to obtain sufficient digester gas when it can be used to the greatest advantage. (Author's abstract)
W90-00275

SEQUENCING BATCH ANAEROBIC REACTOR FOR TREATING PIGGERY WASTEWATER.
National Univ. of Singapore. Dept. of Civil Engineering.
N. Wun-Jern.
Biological Wastes BIWAED, Vol. 28, No. 1, p 39-51, 1989. 3 fig, 6 tab, 15 ref.

Descriptors: *Anaerobic digestion, *Wastewater reactors, *Wastewater treatment, *Farm wastes, *Animal wastes, Waste disposal, Wastewater disposal, Anaerobic reactor.

A study was performed using a 16-liter batch anaerobic reactor for treating piggery wastewater. Operation of the reactor resembled that of the aerobic sequencing-batch reactor process and was cyclic. Each cycle comprised settle, discharge, feed and react modes. Hydraulic retention times of 15, 10, 5, 3, and 1 day were investigated. Liquid-solid separation within the reactor occurred readily without the aid of flocculating agents, leading to the development of a sludge blanket which could be expanded. Sludge retention times exceeded the hydraulic retention time by a wide margin. For total chemical oxygen demand and total biochemical oxygen demand loading rates of 0.40-6.45 and 0.20-2.45 g/l/day, reductions ranged from 53-85 % and 68-89 %, respectively. Transient-state gas quality was very stable and methane content ranged between 76 and 80 %. Rising gas bubbles did resuspend some settled sludge during settle leading to quantities of suspended material leaving the reactor. The reactor required very little operator attention since it was effectively controlled by a microprocessor controller. (Author's abstract)
W90-00308

EFFECTS OF ANIMAL WASTE CONTROL PRACTICES ON NONPOINT-SOURCE PHOSPHORUS LOADING IN THE WEST BRANCH OF THE DELAWARE RIVER WATERSHED.
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
For primary bibliographic entry see Field 5G.
W90-00331

LAND USE IMPACTS OF PRIVATE SEWAGE SYSTEMS IN WISCONSIN.
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 4C.
W90-00336

ASSESSMENT OF TOXIC METAL BIOSORPTION BY ACTIVATED SLUDGE FROM THE TREATMENT OF COAL-GASIFICATION EFFLUENT OF A PETROCHEMICAL PLANT.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Microbiology.
H. C. Kasan, and A. A. W. Baecker.
Water Research WATRAG, Vol. 23, No. 7, p 795-800, July 1989. 3 fig, 2 tab, 34 ref.

Descriptors: *Toxic wastes, *Industrial wastewater, *Wastewater treatment, *Activated sludge, *Heavy metals, *Chelation, *Bioaccumulation, *Coal gasification wastes, Nickel, Copper, Iron, Zinc, Chromium, Isotherms.

A standardized EDTA treatment was used to chelate sludge-bound metal ions from activated sludge from the coal-gasification effluent of a petrochemical plant. The sludge was then equilibrated with solutions increasing to 100 mg/l Ni, Cu, Fe, Zn and Cr individually and in combination. Metal biosorption by sludge was quantified and adsorption was analyzed at 25 and 37 C using Nelson's interpretation of the Langmiur Model. Adsorption of Ni, Cr, Cu and Fe increased independently of temperature when applied as single solutions, whereas Cr and Fe adsorption diminished at 37 C when applied as mixtures of all metals. Affinity series constructed from Nelson equilibrium constants derived from adsorption isotherms showed that Ni was removed with greatest efficiency from single solutions but with less efficiency from mixtures, suggesting that Ni site-specificity may occur. (Author's abstract)
W90-00410

MODELING OF AN OZONE-WASTEWATER SYSTEM'S KINETICS.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and M. Ahmed.
Water Research WATRAG, Vol. 23, No. 7, p 809-815, July 1989. 4 fig, 6 tab, 26 ref. Saudi Arabian National Center for Science and Technology Grant SANCST AR-3-018.

Descriptors: *Wastewater treatment, *Ozone, *Mass transfer, *Kinetics, *Chemical oxygen demand, Mathematical models.

The mass transfer of ozone into aqueous solution is important in both disinfection and reduction of organic matter, i.e. the more ozone transferred into the solution the better the disinfection and the less the amount of organic matter left in the effluent. The mathematical model proposed by Sheffer and Esterson for an ozone-tap water system is modified to predict the amount of ozone input required for a given ozone residual, and COD in an actual ozone-wastewater system. Knowing the amount of ozone needed as input to obtain a specific ozone residual in a given wastewater can prevent wastage of ozone and conserve energy for a required degree of treatment. The values of ozone mass transfer rate, ozone decomposition rate and ozone reaction rate obtained by using the proposed model are similar to the values reported in the literature. Thus it may be concluded that both the data obtained and the model developed in this study are valid. This model could be used to predict the amount of ozone input required for a desired ozone residual, and COD in an ozone-wastewater system. Knowning the amount of ozone concentration in the wastewater can prevent wastage of ozone and conserve energy. (Author's abstract)
W90-00412

PERFORMANCE EVALUATION OF BIOFILM REACTORS USING GRAPHICAL TECHNIQUES.
Illinois Univ., Urbana. Dept. of Civil Engineering.
M. T. Suidan, Y. T. Wang, and B. R. Kim.
Water Research WATRAG, Vol. 23, No. 7, p 837-844, July 1989. 9 fig, 1 tab, 9 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Biofilm reactors, *Fluidized beds, *Packed beds, Graphical methods, Nomograms.

The dimensionless steady-state flux, J*, of substrate into a biofilm can be expressed as a function of the concentration of substrate in the bulk, Sb*, the thickness of the stagnant liquid layer surrounding the biofilm, L*, and the minimum concentration of substrate capable of sustaining growth, Smin*. Using a simplified algebraic expression that relates J* to Sb*, L* and Smin*, a series of nomograms were developed that give the performance of completely mixed (fluidized-bed) and plug-flow (packed-bed) biofilm reactors as a function of process parameters such a hydraulic retention time, kinetic constants and hydrodynamic conditions. This procedure, which is presented in the form of design nomograms, can be used to estimate the reactor empty-bed detention time that is needed to achieve a certain degree of waste stabilization when operated at steady-state. Biofilm reactors that are amenable to analysis using this procedure include fluidized-bed and packed-bed anaerobic, aerobic or anoxic reactors. It should be noted that in the development of the nomograms, the modeled substrate was assumed to be the rate-limiting substrate throughout the biofilm reactor. Thus the nomograms do not consider the potential for dual-substrate limitation. (Author's abstract)
W90-00416

FILTRATION STUDIED WITH ENDOSCOPES.
University Coll., London (England). Dept. of Civil and Municipal Engineering.
For primary bibliographic entry see Field 5F.
W90-00419

DENITRIFICATION IN A TRICKLING FILTER BIOFILM STUDIED BY A MICROSENSOR FOR OXYGEN AND NITROUS OXIDE.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
N. P. Revsbech, P. B. Christensen, L. P. Nielsen, and J. Sorensen.
Water Research WATRAG, Vol. 23, No. 7, p 867-871, July 1989. 4 fig, 24 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Trickling filters, *Biofilms, *Nitrates, *Denitrification, *Oxygen, *Nitrogen oxides, Microsensors.

A newly developed microsensor for oxygen and nitrous oxide was used to study denitrification in a trickling filter biofilm where the reduction of the denitrification intermediate nitrous oxide was inhibited with acetylene. The experimentally obtained nitrous oxide profiles and a diffusion-reaction model were used to obtain microprofiles of denitrification. Denitrification was restricted to deeper anaerobic layers of the biofilm. Both the total intensity and the thickness of the denitrifying zone increased when the NO3(-) concentration in the bulk waterphase was elevated from 200 to 750 microM. Addition of 5 mM acetate plus 0.2% yeast extract resulted in a considerable stimulation of the total activity, but the thickness of the denitrification zone decreased. Photosynthetic activity inhibited denitrification by introduction of oxygen into the deeper layer. (Author's abstract)
W90-00420

IDENTIFICATION OF FILAMENTOUS MICROORGANISMS FROM ACTIVATED SLUDGE: A COMPROMISE BETWEEN WISHES, NEEDS AND POSSIBILITIES.
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Wanner, and P. Grau.
Water Research WATRAG, Vol. 23, No. 7, p 883-891, July 1989. 5 fig, 38 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Bulking sludge, *Foaming, *Filamentous bacteria, *Biological wastewater treatment, Eikelboom types, Algae.

An excessive appearance of filamentous microorganisms in the biocenosis of activated sludge leads to two nuisance cases: activated sludge debulking and activated sludge foaming. A proper identification of filamentous microorganisms enables: (1) to predict what kind and which extent of problem is to be expected, (2) to estimate the causes of the presence of the filaments in the biocenosis, and (3) to rectify the bulking and foaming problems. A review of the available techniques for the identification of filamentous microorganisms indicates that the knowledge of a correct taxonomic identification of filamentous microorganisms is helpful but not absolutely necessary for preventing or curing the bulking and foaming problems. Therefore, the identification to types according to Eikelboom is quite sufficient. Most of Eikelboom's types can be classified into 4 groups on the basis of their similarity, occurrence under the same operation conditions and causing of the same problems: (1) oxic zone growers S (Sphaerotilus-like microorganisms), (2) oxic zone growers C (Cyanophycae-like microorganisms, i.e. Leucothrix, Thiothrix and Type 021N), (3) all zone growers A (Microthrix parvicella and other heterotrophic microorganisms capable of utilizing substrate not only under oxic conditions), and (4) foam-forming microorganisms F Nocardia spp, Nostocoida limicola, Type 0092 and other microorganisms producing biosurfactants). Further metabolic studies of all filamentous microorganisms occurring in bulking or foaming activated sludges are necessary for a more accurate classification into the groups. The classification into 4 groups reflects the most frequent bulking and foaming problems in wastewater treatment practice. (Author's abstract)
W90-00422

OCCURRENCE OF CHLOROBENZENES AND PERMETHRINS IN TWELVE U.K. SEWAGE SLUDGES.
Water Research Centre, Medmenham (England).
H. R. Rogers, J. A. Campbell, B. Crathorne, and A. J. Dobbs.
Water Research WATRAG, Vol. 23, No. 7, p 913-921, July 1989. 3 fig, 8 tab, 26 ref.

Descriptors: *Wastewater analysis, *Sludge analysis, *Chlorinated hydrocarbons, *Permethrins, *Insecticides, Gas chromatography, Chlorobenzenes, Sludge disposal.

An analytical method for the determination of chlorobenzenes and cis-permethrin and trans-permethrin in sewage sludge is described and method performance data presented. Twelve U.K. sewage sludges of varying catchment and treatment were analyzed for 11 chlorobenzenes and cis-permethrin and trans-permethrin. The 11 chlorobenzenes occurred at concentrations of the order of <0.01-40.2 mg/kg (dry wt) with the disubstituted compounds being the most abundant. There was a general reduction in concentration with increased chlorine substitution. Pentachlorobenzene was not detected in any of the samples analyzed. The relative abundance of chlorobenzene concentration reflects their widespread industrial and domestic usage. Both cis-permethrin and trans-permethrin were detected in sewage sludges in the range <0.15 (not detected) to 40.8 mg/kg (dry wt) and in most of the sludges the ratio cis/trans was similar to that in commercial formulations. Four sewage sludge samples from a single treatment works were collected over a period of a year and the range of concentrations of chlorobenzenes and permethrins in these samples was comparable to that found in the survey of 12 sludges from different works. The fact that determinants were sometimes not detected in samples may be due to the batch nature of industrial chemical production. Organic contaminants in sewage sludge could cause environmental effects when sludge is applied to agricultural land or when it is disposed at sea. In either case it is not possible at present to determine a 'safe' level for chlorobenzenes or permethrin in sludge but the indications are that the concentration ranges reported here are unlikely to cause immediate concern. In the case of application to land, former studies suggest that organic contaminants added to soil in sludge at total rates comparable to those for agricultural pesticides may be acceptable. (Author's abstract)
W90-00426

IMPACT OF TOXIC CHEMICALS ON LOCAL WASTEWATER TREATMENT PLANT AND THE ENVIRONMENT.
Toledo Univ., OH.
For primary bibliographic entry see Field 5B.
W90-00448

METHANOGENIC TOXICITY REDUCTION OF 2,4-DINITROPHENOL BY OZONE.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
Y. Wang, P. Pai, and J. L. Latchaw.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 1, p 33-41, Winter 1989. 6 fig, 2 tab, 13 ref. DOI project no. 87-03.

Descriptors: *Bioassay, *Phenols, *Wastewater treatment, *Ozonation, *Wastewater reactors, *Methane, *Biodegradation, *Toxicity, Dinitrophenol, Biochemical methane potential, Anaerobic toxicity assay.

Two types of batch studies, the Biochemical Methane Potential and the Anaerobic Toxicity Assay, were performed on ozonated and unozonated 2,4-dinitrophenol to evaluate the anaerobic biodegradability and toxicity of this refractory priority pollutant induced by ozone. Both acetic acid and phenol supplemented cultures were used to allow an independent evaluation of toxicity toward the specific bacterial groups in a mixed methanogenic culture. The reduction was achieved by ozonation. However, the toxicity of ozonation products to the methanogenic culture was reduced as ozone doses were increased. The toxicity of ozonation products formed with 40-60% COD reduction decreased rapidly independent of both the pH during the ozonation reaction and the substrate used in the ATA tests. (Author's abstract)
W90-00459

SIMPLE TECHNIQUES FOR SOURCE REDUCTION OF WASTES FROM METAL PLATING OPERATIONS.
Environmental Protection Service, Edmonton (Alberta). Western and Northern Region.
E. C. Tsai, and R. Nixon.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 1, p 67-78, Winter 1989. 8 fig, 3 tab, 8 ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Water pollution control, *Metal-finishing wastes, Wastewater management, Metal plating operations.

There are various simple techniques that can be used to reduce waste at thge source. These simple techniques represent sound approaches for solving the waste disposal problems faced by the metal plating industry as provincial regulations and municipal sewer use by-laws become more stringent. The techniques available for source reduction of wastes from metal plating operations may be grouped into eight categories: (1) reactive rinsing, (2) counterflow rinsing, (3) dragout minimization, (4) dragout recovery, (5) process modifications/operational changes, (6) material substitutions, (7) waste exchange opportunities, and (8) housekeeping improvements. A technical assistance program in waste reduction was initiated by Environment Canada's Western and Northern Region in the fall of 1986. It offers assistance in plant waste assessment and training on how to reduce waste. Four metal plating plants have benefited from the waste assessment component. One training course, which attracted 33 platers, has been held on metal plating waste management. The program demonstrates that government and industry can work together in a constructive way to solve waste management problems. Environment Canada administers two financial incentive programs for pollution control and prevention. (Miller-PTT)
W90-00460

CATALYTIC DESTRUCTION OF HAZARDOUS ORGANICS IN AQUEOUS WASTES: CONTINUOUS REACTOR SYSTEM EXPERIMENTS.
Battelle Pacific Northwest Labs., Richland, WA.
E. G. Baker, L. J. Sealock, R. S. Butner, D. C. Elliott, and G. G. Neuenschwander.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 1, p 87-94, Winter 1989. 4 fig, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Hazardous materials, *Organic compounds, Methane, Carbon dioxide, Costs, Wastewater reactors.

A catalytic process for destroying hazardous organics in aqueous wastes, developed by Pacific Northwest Laboratory. Batch reactor tests showed that wide variety of organic compounds could be converted to innocuous gases, primarily methane and carbon dioxide, by treating the wastes at 350 C to 400 C and 3000 to 4000 psig in the presence of a nickel catalyst. Experiments in a continuous reactor system (CRS) showed the destruction of two model organic compounds, p-cresol and MIBK, to be first order. Using the first-order rate constants calculated from the CRS reaction data, the calculated residence time required for 99.9% destruction in a large-scale, plug-flow tubular reactor is about 10 min. no catalyst deactivation was noted except in batch reactor tests with chlorinated compounds. Pacific Northwest Laboratory is working with Onsite*Ofsite, Inc. to transfer the technology to industry. Onsite*Ofsite has completed a preliminary design and cost estimate for a commercial scale (150 gpm) facility. Based in this cost estimate, the cost to treat aqueous wastes containing hazardous organics would be about $0.02 to $0.03 per gallon. (Miller-PTT)
W90-00461

BIOKINETIC CONSTANTS OF A MIXED MICROBIAL CULTURE WITH MODEL DIESEL FUEL.
Sybron Chemicals, Inc., Salem, VA.
For primary bibliographic entry see Field 5G.
W90-00463

IMPROVED UNDERSTANDING AND APPLICATION OF HAZARDOUS WASTE BIOLOGICAL TREATMENT PROCESSES USING MICROBIAL SYSTEMS.
Tennessee Univ., Knoxville. Dept. of Chemical Engineering.
J. W. Blackburn.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 173-193, Spring 1989. 16 fig, 1 tab, 43 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Activated sludge process, *Microbial degradation, *Hazardous materials, *Biotransformation, Naphthalene.

A systems analysis technique, known as the frequency response method, was used to characterize the system structure, and the stability and robustness of naphthalene biotransformation in an activated sludge-type system. The continuous system was perturbed with a complex wastewater feed stream containing a sinusoidally-varying naphthalene concentration while all other reactor operating parameters were held nearly constant. Time series offgas analysis for naphthalene provided a sensitive output parameter that was readily measured and related to the naphthalene reactor liquid concentration. The feed input pertubation period

was varied in successive intervals from 64 to 1 hr, and intervening sequences of constant naphthalene feed concentration allowed the system to relax after each pertubation interval. Using an unsteady-state, difference equation-based naphthalene material balance with an assumed first-order naphthalene biotransformation rate equation, a first-order biotransformation rate parameter (or rate constant) was calculated and was used as an indicator for interpretation of the unexpectedly complex, dynamic naphthalene biotransformation activity. Frequency response analysis of mixed microbial systems was found to be a feasible and useful tool with which to probe the dynamic behavior of biotransformation activity in an operating biological treatment system. This information can give rise to new hypotheses and, hopefully, new understanding regarding the nature of biotransformation in complex systems. The resulting knowledge should also improve the potential for process control, optimization, and scaleup. Dynamic testing and evaluation protocols for activities in natural and environmental microbial systems based on frequency response systems analysis methods are also feasible and could evolve into a process selection criterion to maximize the success of demonstrations and field-scale applications through early identification of the most stable and robust processes. (Author's abstract)
W90-00465

SUPPLEMENTAL CARBON USE BY MICROORGANISMS DEGRADING TOXIC ORGANIC COMPOUNDS AND THE CONCEPT OF SPECIFIC TOXICITY.
Alaska Univ., Fairbanks. Water Research Center.
J. E. Lindstrom, and E. J. Brown.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 195-200, Spring 1989. 2 fig, 22 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Water pollution treatment, *Biodegradation, *Decontamination, *Microorganisms, *Toxicity, Degradation, Carbon, Carbon-limited systems, Nutrients.

A biological treatment mechanism, involving the use of carbon-limited systems for enhanced degradation of toxic organic compounds, is discussed. Biological treatment can be used to decontaminate soil and water polluted by toxic organic compounds. Some compounds are metabolized too slowly under natural conditions to be effectively removed. The technical literature contains several examples where nutrient manipulation has been used to enhance microbial metabolism. One promising technique fir increasing absolute biodegradation rates of organic toxins is to augment microbial biomass by adding a supplemental carbon substrate. Simultaneous metabolism of the toxic and supplemental substrates requires maintenance of growth limiting carbon concentrations in culture to avoid catabolite repression. Populations of microorganisms can metabolize very low levels of organic toxins at accelerated rates when an ancillary carbon source is supplied. Cell-specific degradation rates mat remain unchanged, but absolute removal rates are increased by virtue of increased biomass. Ancillary carbon can also stabilize a population of microorganisms in the presence of high and otherwise inhibitory concentrations of organic toxins. In such cases where organic toxin levels are high and biomass is augmented by supplemental carbon a measure of toxicity is required which accounts for microbial population density as well as toxin concentration. This second order parameter is called specific toxicity. (Author's abstract)
W90-00466

BIOLOGICAL DEGRADATION OF XENOBIOTICS IN WASTE MANAGEMENT.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5G.
W90-00467

ONSITE BIOLOGICAL TREATMENT OF AN INDUSTRIAL LANDFILL LEACHATE: MICROBIOLOGICAL AND ENGINEERING CONSIDERATIONS.
DETOX, Inc., Dayton, OH.
G. L. Skladany.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 213-222, Spring 1989. 3 fig, 1 tab, 6 ref.

Descriptors: *Water pollution treatment, *Wastewater treatment, *Biological wastewater treatment, *Landfills, *Leachates, Toluic acids, Engineering, Microbiological studies.

Successful biological treatment of groundwaters, leachates, or industrial process waters requires the combined action of basic microbiological processes with sound process engineering designs. Such a treatment system is then able to both efficiently and cost-effectively remediate the contaminants present. In this case study, laboratory treatability studies were initially used to demonstrate that toluic acids present in an industrial landfill leachate were amenable to biological treatment. A continuous flow submerged fixed-film bioreactor was then chosen as the optimal equipment design for use at the site. The system was designed to treat a leachate flow of 800 to 2000 gallons per day (gpd) containing total isomeric toluic acid concentrations of 300 to 400 parts per million (ppm). The treatment equipment has been in continuous operation since July 1987. During this period, the total influent isomeric toluic acid concentration has decreased to approximately 45 ppm, and specific effluent toluic acid concentrations have remained below the 0.5 ppm detection limit. (Author's abstract)
W90-00468

INFLUENCE OF PH ON ADSORPTION OF DYE-CONTAINING EFFLUENTS WITH DIFFERENT BENTONITES.
Thessaloniki Univ., Salonika (Greece). Lab. of Organic Chemical Technology.
I. Arvanitoyannis, I. Eleftheriadis, and E. Tsatsaroni.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1707-1711, 1989. 3 fig, 1 tab, 10 ref.

Descriptors: *Adsorption, *Bentonite, *Hydrogen ion concentration, *Dyes, *Color removal, *Wastewater treatment, Separation techniques, Adsorbents, Clay minerals.

The influence of pH on different types of bentonites for color removal from dye containing effluents was examined. All experiments were conducted at room temperature at pH 3, 5, 9, or 11. In preparation for each run, a 500 ml vol of 50 ppm dye solution concentration was placed in cylindrical vessel and different amounts of bentonite (0-1 g/l) were added. The mixture was stirred rapidly with a magnetic stirrer at 200 rpm for 20 min. Samples of 10 ml were drawn from the vessel with the aid of a pipette at different time intervals and filtered through a 0.45 micron paper before analysis. The dyes studied were : C.I. Acid yellow 23, C.I. No. 191402; C. I. Direct red 23, C.I. No. 29160; and C.I. Basic Violet 10, C.I. No. 45170. The bentonites used were: A Ingelheim (Boeringer Ingelheim Granulat Calcium), B Vinobent (Boeringer Ingelheim Granulat Sodium-Calcium) and C Greek Bentonite. The efficiency of bentonites in removing color was higher for acid dye at pH 11 (85-100%) than pH 9 (65-90%). Adsorption at pH 7 was 45-55%, while at pH 3 and 5 no considerable change in dye adsorption degree was observed in comparison to pH 7. There was a further increase in dye adsorption degree for basic dye at pH 3 (95-100%) and pH 5 (95-100%) compared with pH 7 (60-90%). At pH 9 and 11 bentonite adsorption efficiency remains at the same range with that of pH 7. The observed higher adsorption degree of Vinobent for basic dye (compared with the other two bentonites) can be probably attributed to its considerably lower content in Na, Ca and Fe. It is theorized that the dyes dissociate at lower pH such as 3 and 5 and are better adsorbed in bentonites through ionic bonds. (Geiger-PTT)
W90-00469

FATE OF CHLOROBENZENES AND PERMETHRINS DURING ANAEROBIC SEWAGE SLUDGE DIGESTION.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. W. W. Kirk, H. R. Rogers, and J. N. Lester.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1771-1784, 1989. 12 fig, 5 tab, 19 ref.

Descriptors: *Chlorobenzenes, *Insecticides, *Wastewater treatment, *Anaerobic digestion, Biodegradation, Sludge digestion, Separation techniques.

Mixed primary sewage sludge was incubated anaerobically with and without azide addition to prevent biological activity. The behavior of 1,3-, 1,4-, and 1,2-dichlorobenzene, 1,3,5-, 1,2,4-, and 1,2,3-trichlorobenzene, 1,2,3,4-, and 1,2,4,5-tetrachlorobenzene, hexachlorobenzene, and cis-, and trans-permethrin was examined to determine their potential removal during anaerobic digestion. All the chlorobenzenes were removed to varying extent over 32 days of incubation, ranging from 25% removal for 1,3,5-trichlorobenzes to 80% removal for 1,4-dichlorobenzene. Biodegradation may have been responsible for the reductions in 1,3-, and 1,4-dichlorobenzene and 1,2,4-, and 1,2,3-trichlorobenzene as there was no significant removal of these compounds in azide treated sludge. The removal over 32 days of cis-, and trans-permethrin was 87% and 96%, respectively. These removals were attributed to a chemical or physical process. (Author's abstract)
W90-00470

EFFECT OF SMALL CHANGES IN INCUBATION TEMPERATURE ON THE FIVE DAY BIOCHEMICAL OXYGEN DEMAND TEST.
Trinity Coll., Dublin (Ireland).
For primary bibliographic entry see Field 5A.
W90-00487

BOD INCUBATORS AND TEMPERATURE VARIABILITY.
Trinity Coll., Dublin (Ireland).
For primary bibliographic entry see Field 5A.
W90-00488

LEAKAGE OF MERCURY FROM CHELATE RESIN COLUMNS BY CHELATE DETACHING.
Kanazawa Univ. (Japan). Dept. of Chemistry.
T. Chohji, C. Nakagawa, E. Hirai, and Y. Hayashi.
Environmental Technology Letters ETLEDB, Vol. 10, No. 3, p 269-274, March 1989. 5 fig, 9 ref.

Descriptors: *Leakage, *Mercury, *Chelating agents, *Wastewater treatment, Monitoring, Atomic absorption spectrophotometry, Adsorption.

It is known from experience that mercury leaks from chelate resin columns which are used for mercury wastewater treatment. One of the reasons for the mercury leakage phenomena is discussed. After shaking a synthetic mercury wastewater with chelate resin, the supernatant became turbid. Using a highly sensitive atomic absorption spectrophotometric mercury analysis, it was found that the results at lower mercury concentrations deviated from the Freundlich relation. From the results, it was presumed that the chelate component was detached by friction in the process of packing chelate resin into the column, and this chelate component adsorbed mercury while passing through the column. (Author's abstract)
W90-00489

STUDIES ON THE REMOVAL OF SOME TOXIC METAL IONS: II. REMOVAL OF LEAD AND CADMIUM BY MONTMORILLONITE AND KAOLINITE.
Roorkee Univ. (India). Dept. of Chemistry.
S. K. Srivastava, R. Tyagi, N. Pant, and N. Pal.
Environmental Technology Letters ETLEDB, Vol. 10, No. 3, p 275-282, March 1989. 11 fig, 3 tab, 14 ref.

Descriptors: *Kaolinite, *Lead, *Cadmium, *Wastewater treatment, Water treatment, Adsorp-

tion, Montmorillonite, Surfactants, Thermodynamics, Separation techniques, Hydrogen ion concentration.

Clay samples (montmorillonite and kaolinite) have been characterized and used for the removal of lead and cadmium metals. The adsorption of Pb(++) and Cd(++) is greater on montmorillonite, and the sorption capacity increases with increasing pH. Adsorption on montmorillonite follows the Langmuir model. The uptake is found to decrease in the presence of cationic surfactants while the anionic surfactants enhance the removal of the two metal ions. Kinetic runs were made to have an idea of the mechanistic aspects and obtain the thermodynamic parameters of the process. In general the uptake decreases with increasing temperature. (Author's abstract)
W90-00490

PHOTODEGRADATION OF 2-ETHOXY- AND 2-BUTOXYETHANOL IN THE PRESENCE OF SEMICONDUCTOR PARTICLES OR ORGANIC CONDUCTING POLYMER.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
C. Minero, V. Maurino, L. Campanella, C. Morgia, and E. Pelizzetti.
Environmental Technology Letters ETLEDB, Vol. 10, No. 3, p 301-310, March 1989. 7 fig, 3 tab, 21 ref. Eniricerche, MPI, Regione Piemonte, ERO Contract DAJA 45-85-C-0023 and EEC Contract EV4V-0068-C.

Descriptors: *Photolysis, *Alcohols, *Polymers, *Catalysts, *Organic compounds, *Wastewater treatment, Fate of pollutants, Carbon dioxide, Iodine, Industrial wastes.

The degradation of 2-ethoxy-, and 2-butoxyethanol by simulated sunlight has been investigated in the presence of aqueous suspensions of TiO2 as well as an organic conducting polymer (polyphenylacetylene doped with iodine). Degradation in the presence of TiO2 particles was very rapid and effective, leading to a quantitative formation of CO2. Proper conditions also permit a very efficient degradation with the conducting polymer. The method was found to be applicable to a large number of organic compounds and shows promise when used on a stationary support. When the photocatalyst is supported on glass beads or on walls, polluted waters may be treated through the recirculation mode in the photoreactor. (Geiger-PTT)
W90-00492

ANOXIC-AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE: I. SOLIDS REDUCTION AND DIGESTED SLUDGE CHARACTERISTICS.
Ministry of Environment, Nanaimo (British Columbia).
C. J. Jenkins, and D. S. Mavinic.
Environmental Technology Letters ETLEDB, Vol. 10, No. 4, p 355-370, April 1989. 7 fig, 5 tab, 13 ref.

Descriptors: *Activated sludge, *Sludge digestion, *Aerobic digestion, *Wastewater treatment, *Anaerobic digestion, Aeration, Biological wastewater treatment, Cost analysis, Nitrogen removal, Phosphorus removal.

The feasibility of incorporating, at regular intervals, non-aerated conditions in aerobic sludge digestion was demonstrated in laboratory reactors. The advantages associated with aerobic digestion compared to anaerobic digestion include improved supernatant quality, formation of stable end-products, and equal volatile solids reduction for secondary sludges. However, higher energy costs are associated with aerobic digestion because of aeration requirements. Three digestion models (anoxic-aerobic, aerobic with lime control, and aerobic) were investigated in laboratory reactors at 20 and 10 C using secondary raw sludge from the University of British Columbia Pilot Plant. For each mode and temperature, solids retention times of 10, 15 and 20 days were examined. Results showed that anoxic-aerobic digestion yielded comparable percent solids reduction, despite using only 42% as much air. Anoxic-aerobic digestion also maintained neutral mixed-liquor pH levels at no cost. In addition, significant nitrogen removal (up to 32%) and reduced phosphorus release were realized. Anoxic-aerobic and aerobic digestion with lime addition showed the most promise, with respect to retention of percent phosphorus within the solids. (Geiger-PTT)
W90-00493

ANOXIC-AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE: II. SUPERNATANT CHARACTERISTICS, ORP MONITORING RESULTS AND OVERALL RATING SYSTEM.
Ministry of Environment, Nanaimo (British Columbia).
C. J. Jenkins, and D. S. Mavinic.
Environmental Technology Letters ETLEDB, Vol. 10, No. 4, p 371-384, April 1989. 7 fig, 5 tab, 13 ref.

Descriptors: *Aerobic digestion, *Activated sludge, *Sludge digestion, *Wastewater treatment, *Lime, *Anaerobic digestion, Biological wastewater treatment, Nitrates, Ammonia, Nitrification, Denitrification, Oxidation-reduction potential.

The feasibility of incorporating, at regular intervals, non-aerated conditions in aerobic sludge digestion was demonstrated in laboratory reactors. Anoxic-aerobic digestion resulted in superior supernatant quality over aerobic digestion with and without lime conditioning. Soluble nitrate levels within the anoxic-aerobic supernatant were generally < 5.0 milligrams/liter as N. In contrast, nitrate levels in the lime control ranged between 80 and 175 milligrams/liter as N, and levels within the aerobic control ranged between 75 and 100 milligrams/liter as N. Supernatant soluble phosphorus levels, within the anoxic-aerobic digesters, were approximately equal to those within the lime controls and were one-half to one-third the levels within the purely aerobic controls. There was complete denitrification within the anoxic-aerobic digesters. The rate of nitrogen removal was 2 to 3 times that of either of the controls. Oxidation-reduction potential (ORP) proved to be a valuable tool for the monitoring of anoxic-aerobic digesters. Based on an overall rating system, anoxic-aerobic digestion rated higher than the lime control which, in turn, rated higher than the aerobic control. (Geiger-PTT)
W90-00494

USE OF PEAT IN THE REMOVAL OF OIL FROM PRODUCED WATERS.
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, and G. N. Mathavan.
Environmental Technology Letters ETLEDB, Vol. 10, No. 4, p 385-394, April 1989. 8 fig, 3 tab, 16 ref.

Descriptors: *Peat, *Wastewater treatment, *Oil pollution, *Cleanup operations, Adsorption, Kinetics, Model studies, Separation techniques, Oily water.

Horticultural peat was used to assess its potential for the removal of oil from produced waters recovered from the petroleum field operations. Batch kinetic and adsorption studies were conducted using a jar test apparatus. Washed and air-dried sphagnum peat in weights of 1, 0.5 and 0.1 g were mixed with 200 milliliters of the oil-water emulsion at 60 rpm. Isotherm analyses of the kinetic data showed that generally the adsorption pattern followed the Langmuir and the Freundlich isotherms. Column studies using a 300 mm depth of peat on an 8-hr run with flow rates of 12 and 48 milliliters/min (2.13 and 8.52/md) showed an average oil removal of approximately 80%. Scale-up and kinetic models based on column breakthrough data, were utilized to design a peat adsorption column for treating a flow of 150 cu m/day produced waters. (Author's abstract)
W90-00495

REMOVAL OF COPPER FROM SOLUTION USING MOSS.
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
C. K. Lee, and K. S. Low.
Environmental Technology Letter ETLEDB, Vol. 10, No. 4, p 395-404, April 1989. 9 fig, 2 tab, 17 ref.

Descriptors: *Mosses, *Copper, *Wastewater treatment, *Industrial wastewater, Column separation, Adsorption, Separation techniques, Heavy metals, Ion exchange, Lead, Zinc, Model studies.

The ability of moss, Calymperes delessertii Besch, to remove copper from solution was studied in both column and batch experiments using simulated wastewater. The effects of pH, sorbent dosage, copper concentration, temperature, contact time, column height, flow rate, and the presence of other metal ions were also examined. Results showed that the moss is an efficient sorbent for copper removal and the mechanism is mainly an ion-exchange process. The contact time experiments showed that the rate of sorption is fast. The presence of equimolar amounts other metal ions in the solution does not hamper the uptake of copper. The fixed bed experiments indicated that the moss can be used in clean-up systems to remove copper from industrial wastewater and the rate at which it has to be replaced can be predicted from laboratory experiments using the bed-depth service time (BDST) model. Copper from dilute solutions can also be preconcentrated on the moss column and used for analysis of trace amounts of copper in wastewater. Copper could easily be desorbed from the column with 1 M HNO3. (Geiger-PTT)
W90-00496

DEGRADATION OF PHENOL, SELECTED CHLOROPHENOLS AND CHLOROPHENOXY HERBICIDES DURING ANAEROBIC SLUDGE DIGESTION.
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
P. W. W. Kirk, and J. N. Lester.
Environmental Technology Letters ETLEDB, Vol. 10, No. 4, p 405-414, April 1989. 6 fig, 2 tab, 28 ref.

Descriptors: *Degradation, *Phenols, *Herbicides, *Anaerobic digestion, *Wastewater treatment, *Sludge digestion, Industrial wastes, Chlorinated hydrocarbons, Fate of pollutants, Biodegradation.

The behavior of phenol, 2-chlorophenol, 4-chloro-3-methyl phenol and four chlorophenoxy herbicides has been assessed during the anaerobic incubation of digested sewage sludge under active and sterile conditions. An initial decline in phenol concentration in active sludge may be a result of biodegradation. Phenol then increased under both sets of conditions presumably via a biotic or abiotic mechanism. The subsequent decline in phenol concentration was presumed to be the result of further biodegradation. The chlorophenols degraded most rapidly in the active sludge with concentrations being undetectable after 4 to 8 days. Three of the four herbicides were degraded in active and sterile sludge, while the poor analytical recovery of the fourth precluded any firm conclusion. (Geiger-PTT)
W90-00497

ANAEROBIC TREATMENT OF MUNICIPAL SEWAGE IN UASB AND AFBR REACTORS.
Valladolid Univ. (Spain). Dept. of Chemical Engineering.
I. Sanz, and F. Fdz-Polanco.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 453-462, May 1989. 8 fig, 4 tab, 20 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Anaerobic conditions, *Biological wastewater treatment, *Domestic wastes, Fluidized bed process, Chemical oxygen demand, Biochemical oxygen demand, Suspended solids, Performance evaluation.

Laboratory scale reactors of the Upflow Anaerobic Sludge Blanket (UASB) and the Anaerobic Fluidized Bed Reactor (AFBR) were used to

evaluate the performance of these two systems in treating domestic wastewater. Both reactors were fed domestic sewage (CODt = 500 milligrams/liter, BOD5 = 325 milligrams/liter and TSS = 190 milligrams/liter) at 20 C for 320 days. The AFBR had fewer problems during the starting-up trial than the UASB. Better removal of CODt, BOD5 and TSS were achieved with the AFBR, even at lower hydraulic retention times. The fluctuations in the influent CODt, (and therefore, in the organic loading rate), had no effect in the AFBR, but had a significant influence on the UASB reactor. (Geiger-PTT)
W90-00499

TEST FOR CHARACTERIZING SETTLEABILITY OF ANAEROBIC SLUDGE.
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
E. Andras, K. J. Kennedy, and D. A. Richardson.
Environmental Technology Letters, Vol. 10, No. 5, p 463-470, May 1989. 7 fig, 14 ref.

Descriptors: *Anaerobic conditions, *Sedimentation, *Settleable solids, *Flow velocity, *Wastewater treatment, Suspended solids.

A simple, inexpensive upflow velocity method for evaluating settling properties of granular sludges from sludge bed reactors is described. A sludge sample from the reactor is placed in a 20 cm long and 2.50 cm in diameter glass column and subjected to gradually increasing upflow velocities. A variable speed peristaltic pump pumps 33-35 C water through the test column in an upflow mode. Ten different flow velocities, in ascending order, are maintained for 5 min each. Granules exit the glass column via an overflow port. the fraction of sludge exiting at each particular velocity is collected on filter paper, photographed, and the dry weight of each fraction determined. Percentage of suspended solids exiting the glass column plotted against upflow velocity gives the settling velocity profile of a particular sample. This test can be coupled to granule size determination, microscopy, chemical analysis and specific acetoclastic or methanogenic activity tests to achieve a clearer understanding of the granulation process. (Geiger-PTT)
W90-00500

EFFECTS OF OPERATIONAL PARAMETERS ON THE SETTLING PROPERTIES OF ACTIVATED SLUDGE.
Middle East Technical Univ., Ankara (Turkey). Dept. of Environmental Engineering.
G. Surucu, and S. Soyupak.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 471-478, May 1989. 2 fig, 4 tab, 24 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Sedimentation, *Biological wastewater treatment, *Mathematical studies, Performance evaluation, Settleable solids, Mathematical models, Statistical analysis, Retention time, Kinetics.

Settling properties of activated sludge typically establish the performance and the cost of biological wastewater treatment plants, and they are considerably affected by the solids concentration of the sludge and the mean cell residence time of the system. The effects of mean cell residence time of the system and solids concentration of sludge on the settling properties of activated sludge were studied in a laboratory scale semi-continuous reactor. Results showed that the zone settling velocity of sludge decreases exponentially with the increase in solids concentration, as a result of net upward flow of liquid displaced by the settling particles. Statistical analysis of data revealed a relationship between velocity and the solid concentration of sludge. The sludge settled best at a mean cell residence time of 5 days. Shorter and longer mean cell residence caused pin-point flocs and sludge bulking, both of which increased sludge settling time. Statistical analysis of laboratory data revealed that, between the mean cell residence time of the system and the settling velocity of sludge there exist a straight line relationship for mean cell residence values equal or less than five days. For longer mean cell residence times of the system, the relationship can be expressed by a power function. (Geiger-PTT)
W90-00501

SEMI-MICRO C.O.D. DETERMINATION METHOD FOR HIGH-SALINITY WASTEWATER.
Santiago Univ. (Spain). Dept. of Chemical Engineering.
M. Soto, M. C. Veiga, R. Mendez, and J. M. Lema.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 541-548, May 1989. 8 fig, 1 tab, 5 ref. Spanish C.A.I.C.Y.T. Project 466-84.

Descriptors: *Water analysis, *Wastewater analysis, *Chemical oxygen demand, *Wastewater treatment, *Salts, *Sulfates, Chlorides, Oxidation, Suspended solids.

Semi-micro determinations of the chemical oxygen demand (COD) of wastewaters can err considerably if chloride is present. The degrees to which accuracy is influenced by COD itself, the concentration of the masking agent HgSO4 in the digesting solution, the presence of other salts, which is especially relevant in the case of water of marine origin, and some of the other particular characteristics of the wastewater are discussed. The HgSO4/Cl(-) ratio of 10:1 regarded as sufficient by APHA can lead to serious mis-determination, especially when the organic load of the water being analyzed is relatively low. The concentration of HgSO4 recommended by APHA allows COD determination with an error of no more than 3% when the Cl(-)/known COD of the organic load (CODom) ratio of the water analyzed is no greater than 10, though appropriate dilution of the sample may be necessary. Greater HgSO4 concentrations allow the analysis of samples with Cl(-)/COD om ratios of up to 30, but for waters with higher Cl(-)/CODom ratios efficient masking of Cl(-) by HgSO4 is impossible. A suitable working range for COD after dilution of samples of 150-250 milligrams/liter is suggested. The error in COD determination caused by the presence of Cl(-) ions increases with the organic load's resistance to oxidation. This should be considered when analyzing waters with high suspended solid contents. If COD determination is to be performed systematically on a water whose organic load varies as the result of processing (e.g. by anaerobic digestion), a thorough preliminary study similar to that described above should be carried out. (Geiger-PTT)
W90-00505

ACID TREATMENT OF ANAEROBICALLY DIGESTED SLUDGE: EFFECT ON HEAVY METAL CONTENT AND DEWATERABILITY.
University of Manchester Inst. of Science and Technology (England). Pollution Research Unit.
Y. H. Cheung.
Environment International, Vol. 14, No. 6, p 553-561, 1989. 10 fig, 21 ref.

Descriptors: *Digested sludge, *Wastewater treatment, *Sludge drying, *Heavy metals, Wastewater treatment, Acidification, Hydrogen peroxide, Hydrochloric acid, Nitric acid, Sulfuric acid, Sludge utilization, Detoxification, Sludge disposal.

The effects of various common acids (hydrochloric, nitric, and sulfuric), with and without the presence of hydrogen peroxide, on the heavy metal content and dewaterability of digested sludge were investigated. The pH of the sludge dropped quickly with small additions at the beginning (pH dropped from 7.2 to 2 with the addition of 1.90 ml of hydrochloric acid, 1.60 ml of nitric acid, and 1.77 ml of sulfuric acid). Further addition of acid resulted in little further decrease of pH in the sludge. In all the acid treatments, the presence of hydrogen peroxide further decreased the capillary suction time (a parameter reflecting the ability of sludge to be dewatered) and thus improved the dewaterability of the sludge. Further consideration concerning the treatability of the filtrate resulting after liquid-solid separation indicated the advantages of hydrochloric acid. A combination of hydrochloric acid and hydrogen peroxide appears to be useful as a potential secondary sludge treatment method to improve the quality of digested sludge, both in terms of its handleability and reutilization value. The percentage removal of Cu and Pb were increased in the presence of hydrogen peroxide, whereas only a very low percentage removal of such metals could be achieved when hydrochloric acid was used alone. Sewage sludge detoxified by the 'Oxidative Acid Hydrolysis Process' can be subjected to further treatment dependent on the disposal option: it can be disposed of either directly to sea or buried in wasteland, or alternately, it can be reutilized on agricultural land or sold as a supplement for animal feed. (White-Reimer-PTT)
W90-00516

SULFIDE PRODUCTION DURING ANAEROBIC LAGOON TREATMENT OF TAPIOCA WASTEWATER.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, and S. Chatsanguthai.
Environment International, Vol. 14, No. 6, p 563-566, 1989. 3 fig, 2 tab, 6 ref.

Descriptors: *Sulfides, *Hydrogen sulfide, *Food-processing wastes, *Anaerobic lagoons, *Wastewater treatment, Tapioca, Chemical oxygen demand, Hydraulic properties, Odor control, Hydrogen ion concentration, Organic loading.

Laboratory-scale experiments on anaerobic lagoon treatment of tapioca wastewater were conducted under ambient, tropical conditions. The objectives of the study were to investigate factors that affect hydrogen sulfide production and to propose means to control the formation of hydrogen sulfide in lagoon effluents. The concentrations of sulfides were found to increase with increasing organic loading from 2.76 to 5.77 kg COD/cu m/d, decreasing hydraulic retention time; and increasing pH from 3 to 7. The maximum total sulfide concentration of 18.8 mg/L occurred at the organic loading of 5.77 kg COD/cu m/d and neutral pH. The maximum H2S concentration was calculated to be 13.3 mg/L which occurred in the lagoon operated at an organic loading of 5.77 kg COD/cu m/d and a pH of 5. The control of odor problems due to the H2S formation should be possible by raising the pH of the lagoon water to be more than 8 which would convert most of the sulfides to the odorless bisulfide ions HS(-) and S(--), or operating the lagoon at low organic loading so that the production of total sulfide would be reduced. (Author's abstract)
W90-00517

GLYCERIA MAXIMA FOR WASTEWATER NUTRIENT REMOVAL AND FORAGE PRODUCTION.
Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research.
K. Sundblad, and H. B. Wittgren.
Biological Wastes BIWAED, Vol. 27, No. 1, p 29-42, 1989. 1 fig, 5 tab, 27 ref.

Descriptors: *Wastewater disposal, *Wastewater treatment, *Nutrient removal, *Wastewater renovation, *Aquatic plants, *Forages, *Nitrogen, *Phosphorus, Biomass, Wetland filters, Lysimeters, Proteins, Calcium, Potassium.

Potential biomass yield, nutrient uptake capacity and forage quality of Glyceria maxima were tested in four field lysimeters receiving municipal wastewater. Wastewater was applied during 3 years at different frequencies in order to achieve maximum N-reduction in the system. Accordingly two lysimeters were ponded for part of the week. Harvesting (in June and August) progressively favored competing terrestrial species in the non-ponded lysimeters. In year 3 the other species accounted for 65-70% of the harvested biomass in these non-ponded lysimeters. In the ponded lysimeters, reducing conditions in the soil probably prevented terrestrial species from establishing. The total annual yields of the single-species stands in the ponded lysimeters were 870-1165 g/sq m. Energy, protein, P, K, and Ca content of the harvested biomass indicated a high nutritional value. NO3(-)-N concentration in the harvested

biomass varied from 0.08 to 0.32% of dry wt, but did not generally exceed 0.2%. Maximum N and P removed with the harvested biomass was 32 and 4.8 g/sq m respectively. The relative removal of nutrients in ponded lysimeters varied from 26 to 55% of the amount of N applied and from 12 to 28% of P applied, which illustrated the possibilities of adjusting the load for optimization of nutrient re-use rather than disposal. (Author's abstract)
W90-00521

ANAEROBIC LAGOON BIOGAS RECOVERY SYSTEMS.
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
L. M. Safley, and P. W. Westerman.
Biological Wastes BIWAED, Vol. 27, No. 1, p 43-62, 1989. 10 fig, 4 tab, 17 ref.

Descriptors: *Anaerobic lagoons, *Wastewater lagoons, *Animal wastes, *Wastewater treatment, *Biogas, *Methane, Swine wastes, Poultry wastes, Methane recovery, Volatile solids, Floating covers, Temperature.

Floating covers were placed on two anaerobic lagoons to study biogas production. One cover was approximately 370 sq m in size and was located on a lagoon receiving effluent from a poultry anaerobic digester. The second cover was 155 sq m and was located on a swine anaerobic lagoon. The liquid entering the swine lagoon had opportunity for considerable volatile solids (VS) loss prior to entering the lagoon. The poultry and swine lagoons had mean volumetric biogas production rates of 0.07 and 0.05 cu m/cu m-day respectively. The areal biogas production rates were 0.16 and 0.13 cu m/ sq m-day for the poultry and swine lagoons, respectively. The mean methane (CH4) concentrations were 64.8% and 62.0% for the biogas from the poultry and swine lagoons, respectively. It was concluded that: (1) Biogas can be recovered from the surface of anaerobic lagoons using floating covers; (2) Biogas production is controlled by volatile solids loading rate and lagoon liquid temperature. Biogas production dropped appreciably when lagoon liquid temperatures dropped below 13-15 C but again increased once the lagoon liquid temperature increased; (3) Methane concentrations in biogas from lagoons are typically 62% or above except when lagoon liquid temperatures are depressed (< 15 C); and (4) The use of Panelcoils at elevated circulating fluid temperatures (74 C) was not successful. (Author's abstract)
W90-00522

BIO-OXIDATION STUDY OF METHANOL SYNTHETIC WASTEWATER USING THE SBR.
National Univ. of Singapore. Dept. of Civil Engineering.
W. K. Koh, W. J. Ng, and S. L. Ong.
Biological Wastes BIWAED, Vol. 27, No. 2, p 101-113, 1989. 5 fig, 3 tab, 9 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Methanol, *Oxidation process, Organic loading, Sequencing batch reactors, Synthetic wastewater, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen, Organic carbon, Hydrogen ion concentration, Alkalinity, Suspended solids.

Bio-oxidation and biomass generation in a laboratory-scale sequencing batch reactor (SBR) were investigated. The synthetic feed consisted of methanol, inorganic nutrients and a trace elements supplement. The concentrations of the inorganic nutrients and trace elements were kept constant throughout the study, while the methanol concentration was varied to provide the various organic loadings. Four track-monitoring runs (i.e., detail monitoring of parameters within a cycle) were performed, and prior to each track-monitoring program the SBR was subjected to the selected organic loading for at least 2 weeks so as to achieve system stability. The parameters monitored were pH, alkalinity, dissolved oxygen, suspended solids, volatile suspended solids, and dissolved COD, BOD3, TOC and ammonia-N, nitrite-N, and nitrate-N. COD and BOD removal efficiencies were good. The 48-h cycle adopted was found to be sufficient to force the biomass into endogenous respiration, hence controlling the excess biomass formed through assimilation of the feeds organic carbon. Although the ammonia-nitrogen level in the feed was high, nitrification was not observed. Track monitoring of DO and pH was found to provide good indications of the completion of bio-oxidation. (White-Reimer-PTT)
W90-00523

BIOLOGICAL TREATMENT OF PALM OIL MILL EFFLUENT USING TRICODERMA VIRIDE.
Pertanian Malaysia Univ., Serdang. Faculty of Food Science and Biotechnology.
M. I. A. Karim, and A. Q. A. Kamil.
Biological Wastes BIWAED, Vol. 27, No. 2, p 143-152, 1989. 6 fig, 2 tab, 16 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Aquatic fungi, *Food-processing wastes, Chemical oxygen demand, Proteins, Trichoderma.

The treatment of palm oil mill effluent (POME) using the fungus Trichoderma viride was investigated. POME was subjected to four different treatments (raw POME, boiled POME, raw POME with 5% inoculum of spores or mycelium separately, and boiled POME with 5% inoculum of spores or mycelium separately). POME treated with T. viride showed more than 95% reduction in COD value (final COD 44 and 56 mg/L) with sporal or mycelium inoculum at days 14 and 10 of the incubation period respectively. The control samples without fungal inoculation had a COD reduction of 43-52%. The results indicated that the mycelial treatment was more effective than the sporal treatment of the POME in reducing the COD content. There was little difference in COD reduction between the raw and boiled POME inoculated with fungi. The fungus was able to grow well and compete against the indigenous flora in the raw POME resulting in efficient reduction of COD upon incubation. The fungal biomass recovered had a 37.6-40.7% crude protein content, and a yield of 1.37-1.42 g/L (dry wt) mycelium. (White-Reimer-PTT)
W90-00524

ANAEROBIC DIGESTION OF CHEESE WHEY USING UP-FLOW ANAEROBIC SLUDGE BLANKET REACTOR.
Academia Sinica, Guangzhou (China). Inst. of Energy Conversion.
J. Q. Yan, K. V. Lo, and P. H. Liao.
Biological Wastes BIWAED, Vol. 27, No. 4, p 289-305, 1989. 4 fig, 6 tab, 23 ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Wastewater treatment, *Food-processing wastes, Chemical oxygen demand, Sludge blanket reactor, Fatty acids, Suspended solids, Cheese whey.

Anaerobic treatment of cheese whey using a 17.5 L up-flow anaerobic sludge blanket reactor was investigated in the laboratory over a range of influent concentration from 4.5 to 38.1 g/L chemical oxygen demand (COD) at a constant hydraulic retention time of 5 days. A COD reduction of over 97% was achieved. However at the influent concentration of 38.1 g/L COD a reactor instability was observed. The start-up of the reactor could be initiated at a low influent concentration and the influent concentration could be increased step-wise as long as the volatile fatty acid (VSS) concentrations were well removed in the reactor. The preferable loading rate was approximately 0.6 g COD/VSS to ensure favorable conditions for biomass growth. The method proved to be an efficient treatment method for diluted cheese whey. (Author's abstract)
W90-00526

ANAEROBIC-AEROBIC BIOLOGICAL TREATMENT OF A MIXTURE OF CHEESE WHEY AND DAIRY MANURE.
British Columbia Univ., Vancouver. Dept. of Bio-Resource Engineering.
K. V. Lo, and P. H. Liao.
Biological Wastes BIWAED, Vol. 28, No. 2, p 91-101, 1989. 4 fig, 2 tab, 9 ref.

Descriptors: *Biological wastewater treatment, *Food-processing wastes, *Wastewater treatment, *Aerobic treatment, Anaerobic digestion, Chemical oxygen demand, Batch reactors, Rotating reactors, Organic loading, Methane, Whey, Dairy manure.

The integrated anaerobic-aerobic biological treatment system consisted of an anaerobic rotating biological reactor and an aerobic sequencing batch reactor. Three sequencing batch reactors were used in the aerobic process. A mixture of cheese whey and dairy manure was successfully digested in an anaerobic rotating biological contactor which served as a first step in the waste treatment process. The methane (CH4) production rate, which is dependent on the organic loading rate, ranged between 1.43 and 3.74 CH4 per liter reactor per day. As the organic loading rate increased, total methane production also increased. In the anaerobic digestion step, over 46% of COD was removed. The potential pollutants were further destroyed by the aerobic treatment. More than 93% of the remaining COD was removed in the sequencing batch reactors operated at 22 C. The treatment efficiency was lower for the aerobic reactor operated at a lower temperature (10 C). The results indicated that an integrated anaerobic-aerobic treatment of a mixture of dairy manure and cheese whey could produce a substantial amount of methane and reduce the pollution potential. (Author's abstract)
W90-00527

REMOVAL OF SOME HEAVY METALS FROM POLLUTED WATER BY AQUATIC PLANTS: STUDIES ON DUCKWEED AND WATER VELVET.
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
S. K. Jain, P. Vasudevan, and N. K. Jha.
Biological Wastes BIWAED, Vol. 28, No. 2, p 115-126, 1989. 4 fig, 7 tab, 18 ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Aquatic plants, *Iron, *Copper, Heavy metal removal, Duckweed, Water velvet, India.

The uptake of iron and copper by duckweed (Lemna minor L.) and water velvet (Azolla pinnata R.Br) was investigated in solutions enriched with 1.0, 2.0, 4.0, and 8.0 ppm of these two metal ions which were renewed every 2 days over a 14-day test period. The uptake rate of both the metal ions was highest when the initial concentration in the test solutions was 1.0 ppm. The concentrations of iron or copper remaining, after 2 days, in the solutions treated with duckweed or water velvet at 2.0, 4.0, and 8.0 ppm ion level increased over the 14 days, except in solutions treated with water velvet at iron concentrations of 2.0 and 4.0 ppm. The presence of one metal ion in solution decreased the uptake rate of the other metal ion; e.g. when duckweed was kept in a solution containing copper alone at 8.0 ppm level, the value of the metal concentration factor after 14 days was 51.20. However, in the presence of an equal concentration of iron the value of this factor was 26.53, indicating the influence of iron on the uptake of copper. The results demonstrate that duckweed and water velvet are able to remove iron and copper effectively at low concentrations up to 6-8 days of treatment. The uptake potential and survival of water velvet in an iron and copper environment is higher than that of duckweed, but water velvet does not grow from May to October in India. (Author's abstract)
W90-00528

ELECTROBIOLOGICAL WASTEWATER TREATMENT.
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland).
M. Krzemieniewski.
Biological Wastes BIWAED, Vol. 28, No. 2, p

127-132, 1989. 4 fig, 6 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Electrobiological wastewater treatment, Chemical oxygen demand, Electric currents, Biofiltration.

To determine the influence of the passage of electric current on the biodegradation process of the sewage in a moving tape-bed (MTB) which consists of moving, flexible tapes moving over rotating high shafts with the lower parts of the tapes immersed in sewage, experiments were conducted on a laboratory scale prototype. The raw sewage was concentrated, with an average COD of 1550 g O2/cu m. The active surface of the tape was loaded with influent sewage at the rate of 86 g O2/sq m per day, and the retention time in the tank was 0.48 h. The wastewaters were treated in the MTB either with the electric current at 0.2, 0.3, 0.5, 0.6A and 12V, or without the current. Electric current at 0.2A increased the efficiency of the biofilter from 40 to 70%. Very high load reductions were obtained at currents of 0.5 and 0.6A. The treated wastewaters were clearer, and the volume of the brown foam on the surface of the sewage was lower than that in the electrochemical treatment. The chemical precipitates did not interfere with the activities of the biofilm. The low effectiveness of the biological treatment was caused by the very short retention time in the tank, but using this low effectiveness permitted the clear demonstration of the influence of the electric current on the wastewater treatment. (White-Reimer-PTT)
W90-00529

ANAEROBIC DIGESTION OF PIG MANURE WITH DIFFERENT AGRO-INDUSTRIAL WASTES.
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
M. H. Wong, and Y. H. Cheung.
Biological Wastes BIWAED, Vol. 28, No. 2, p 143-155, 1989. 5 fig, 5 tab, 13 ref. Hong Kong Baptist College Grant 85/86-09.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, *Industrial wastes, Farm wastes, Agroindustrial wastes, Cardboard, Newspaper, Sawdust, Sugar cane, Manure, Fertilizers, Methane, Chemical oxygen demand.

Th effectiveness of four types of agroindustrial wastes (cardboard, newspaper, sawdust and sugarcane waste) as a carbon source in the batch anaerobic digestion of pig manure was investigated. Pig manure with either sawdust or cardboard, especially sawdust, produced higher total volumes of biogas than with newspaper or sugar-cane waste. Mixtures in the ratio 4:1 pig manure:sawdust, and 4:1 and 3:1 pig manure:cardboard gave the highest yields of gas with the highest percentage of methane. The total solids, volatile solids and chemical oxygen demand of the digested materials showed that the organic material of the wastes had been substantially decreased by digestion. The fertilizer values of the digested materials were tested by planting Lolium perenne (ryegrass) on sand amended with digested wastes. Pig manure with sugar-cane waste gave the highest crop yield, followed by manure plus cardboard or sawdust. Pig manure with newspaper gave the lowest yield. (Author's abstract)
W90-00530

REMOVAL OF HEAVY METAL IONS FROM AQUEOUS SOLUTIONS WITH MELON (CITRULLUS VULGARIS) SEED HUSKS.
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
F. E. Okieimen, and V. U. Onyenkpa.
Biological Wastes BIWAED, Vol. 29, No. 1, p 11-16, 1989. 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Cadmium, *Copper, *Lead, *Adsorbents, *Melon seed husks, Nigeria, Metal ion removal.

The removal of cadmium, copper, and lead ions from aqueous solutions by melon seed husks was examined by equilibrium and dynamic sorption studies at 29 C. The amounts of the metal ions removed from solution depended on the metal ion type, and were enhanced by EDTA modification of the husks. The distribution coefficient, D, of the metal ions between the adsorbent phase and the bulk aqueous phase showed little variation with the equilibrium concentration of the metal ions, except for Pb(II) ions where the value of D doubled with a five-fold change in the equilibrium concentration. The sorption data fitted the Langmuir isotherm equation and maximum metal-ion binding capacities of 23.3 mg/g husk and 11.4 mg/g husk were predicted for Cd(II) ions and Cu(II) ions respectively. Relatively higher proportions of Pb(II) ions were removed from solution by melon husks in the column experiments. Pb(II) ions sorbed on melon husks can be quantitatively recovered by treatment with dilute acid. (Author's abstract)
W90-00533

BIOTREATMENT OF ANAEROBICALLY DIGESTED SWINE MANURE WITH MICROALGAE.
Laval Univ., Quebec. Groupe de Recherche en Recyclage Biologique et Aquiculture.
J. de la Noue, and A. Basseres.
Biological Wastes BIWAED, Vol. 29, No. 1, p 17-31, 1989. 6 fig, 3 tab, 37 ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Wastewater treatment, *Animal wastes, *Nutrient removal, *Algae, Nitrogen, Phosphorus, Ammonia, Chemical oxygen demand, Chlorella, Scenedesmus, Phormidium, Swine manure.

The ability of three algae species (Chlorella sp., Scenedesmus obliquus, and Phormidium bohneri) to exhaust inorganic nitrogen and orthophosphate and to produce biomasses from anaerobically digested swine manure was tested. The effluent to be treated (COD 7.7 g/L, N-NH4(+) 3.3 g/L, P-PO4(3-) 0.3 g/L, pH 8.0) was diluted with tapwater to final manure concentrations of 0.6-3.0%. Batch culture was carried out in 1 L flasks for 12 days at 10 and 20 C, starting with inocula of 80 mg dry wt algae per liter. Semicontinuous cultures were also performed with P. bohneri. The results showed that biomass production was good (up to 500-750 mg dry wt/L after 12 days) for all three species at 20 C with productivities averaging 31 mg dry wt/L/d for P. bohneri, 37 mg dry wt/L/d for Chlorella sp. and 53 mg dry wt/L/d for S. obliquus. Total N-NH4(+) exhaustion was obtained at 20 C with all three species (2.0% manure) within 12 days; corresponding reduction of P-PO4(3-) was over 90%, and COD abatement was 60-90%, depending on the species. Under natural conditions, the best candidate for batch treatment would appear to be Chlorella sp. Under semicontinuous conditions, P. bohneri, which can be easily harvested, is indeed interesting, with removal rates similar to those obtained with Chlorella sp. grown in batch at similar manure concentration. (Author's abstract)
W90-00534

SEQUENTIAL REDUCTIVE DEHALOGENATION OF CHLOROANILINES BY MICROORGANISMS FROM A METHANOGENIC AQUIFER.
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5B.
W90-00538

EVALUATION OF SEPTIC TANKS PERFORMANCE IN SOME PARTS OF MOSUL CITY IN IRAQ.
Mosul Univ. (Iraq). Saddam Dam Research Centre.
M. A. Al-Layla, and S. M. Al-Rawi.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 5, p 543-556, July 1989. 3 fig, 4 tab, 15 ref.

Descriptors: *Septic tanks, *Iraq, *Wastewater treatment, Settleable solids, Suspended solids, Biochemical oxygen demand, Retention time.

An evaluation of the efficiency of septic tanks in the Mosul region in Iraq in removing BOD, suspended and settleable solids and other constituents was presented. Five districts were selected and then grouped into two areas based on proximity, geographical and geological aspects. The investigation of these tanks showed good removal of pollutants due to prolonged retention time. However, some constructional defects and faulty tank locations affected some systems. In some cases soil type necessitated rapid desludging or effluent overflow which could affect the environment, and oversizing might cause some constructional danger as well as adding unnecessary costs. (White-Reimer-PTT)
W90-00546

SPECIAL DESIGN FEATURES TAKE THE CHILL OUT OF WASTEWATER TREATMENT.
Black and Veatch, Denver, CO.
M. J. Maxwell, R. B. Wenger, and W. L. Earley.
Public Works PUWOAH, Vol. 119, No. 8, p 50-51, July 1989.

Descriptors: *Wastewater treatment, *Cold regions, *Wastewater facilities, *Colorado, *Advanced wastewater treatment, Activated sludge, Flocculation, Filtration, Energy efficiency, Insulation, Temperature, Oxidation process, Aerators, Design criteria.

Wastewater treatment plant design features that combat the elements at two Colorado award-winning facilities are described. The Snake River plant is a 1.2-mgd advanced waste treatment facility that uses a highrate activated sludge system, followed by chemical addition, flocculation, settling, and filtration for phosphorus removal. The plants components (except the secondary flow equalization basins) are housed inside structures, heating requirements are supplied by both gas and electric unit heaters, augmented in two buildings by passive solar clerestory windows, and a special collection system with manholes wrapped in polyethylene and 256-sq ft horizontal layer of rigid insulation buried 1 ft below grade and centered around the manhole. The Gunnison plant is a 4.2-mgd oxidation ditch facility providing secondary treatment. Surface aerators were selected to provide aeration and to propel the mixed liquor around the oxidation basins which retain most heat contained in the raw wastewater. The buildings are insulated with foam insulation between two sheet metal layers, uninsulated aluminum geodesic domes cover both secondary clarifiers and the gravity thickener, and electric unit heaters in normally unoccupied buildings are sized only to keep water from freezing and the interior above 40 F. (White-Reimer-PTT)
W90-00551

NITROGEN REMOVAL WORKS YEAR-ROUND.
Donohue and Associates, Inc., Sheboygan, WI.
E. S. Nevers.
Public Works PUWOAH, Vol. 119, No. 8, p 68, July 1989.

Descriptors: *Wastewater treatment, *Cold regions, *Wisconsin, *Nitrogen removal, *Wastewater facilities, Nitrification, Denitrification, Temperature.

The community of Lake Geneva, Wisconsin decided to use a biological nitrification-denitrification process to meet new nitrogen removal standards. The process uses a recirculating, three-channel oxidation ditch in which microorganisms first oxidize ammonia nitrogen and organic nitrogen, forming nitrate. By removing the oxygen from the nitrates, microorganisms break the compounds into nitrogen gas and oxygen. The facilities design considers the nitrification system's temperature sensitivity through the use of a deep oxidation ditch which minimizes surface area exposure and reduces heat loss. A chlorine contact tank can be added to the hydraulic system in the event of a cold weather process failure. The $5.3-million facility treats an average daily flow of 1.7 mgd. The treated effluent averages less than 6 mg/L of nitrogen, and can

remove nitrogen to 1 mg/L. The facility also achieves effluent BOD concentrations below the 50 mg/L monthly average permitted. (White-Reimer-PTT)
W90-00552

CHARACTERIZATION OF PHOSPHORUS IN SLUDGE EXTRACTS USING PHOSPHORUS-31 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5A.
W90-00568

EFFECTIVENESS OF MECHANICAL AERATION IN FLOATING AQUATIC MACROPHYTE-BASED WASTEWATER TREATMENT SYSTEMS.
Reedy Creek Energy Services, Inc., Lake Buena Vista, FL.
T. A. DeBusk, K. R. Reddy, and K. S. Clough.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 349-354, Jul-Sep 1989. 4 fig, 3 tab, 14 ref.

Descriptors: *Aeration, *Wastewater treatment, *Biological wastewater treatment, *Water hyacinth, *Wastewater lagoons, Biochemical oxygen demand, Suspended solids, Contaminant removal efficiency.

Outdoor tanks containing the floating aquatic macrophyte water hyacinth (Eichhornia crassipes (Mart) Solms) were provided with diffuse aeration to evaluate its effect on wastewater treatment efficiency and plant growth. Light aeration (0.003 and 0.021 L/sq m/min) had no effect on the treatment of primary domestic effluent in the batch-fed water hyacinth tanks. Heavy aeration (1.03 and 3.53 L/sq m/min) raised wastewater dissolved oxygen (DO) concentrations, but did not improve biochemical oxygen demand (BOD5) removal efficiency or increase plant growth rates during 21-d experiments. Heavy aeration slightly increased wastewater N removal, but the effectiveness of aeration for nutrient removal was not consistent among experiments. In continuous-flow raceways fed primary domestic effluent, vigorous aeration (6.1 L/sq m/min) improved effluent quality, with contaminant removal rates averaging 77% BOD5 and 76% SS in nonaerated raceways, and 94% BOD5 and 89% SS in aerated raceways. Results of this study suggest that the high aeration requirement for enhanced contaminant removal in floating aquatic macrophyte systems is due not only to poor O2 transfer efficiencies (1.6-4.0%), but also to the inefficient utilization of O2 for BOD5 removal. The primary benefit of moderate aeration (0.1-1.0 L/sq m/min) in floating aquatic macrophyte systems appears to be the elevation of wastewater DO concentrations (from 0.5 to 2.5 mg/L), which may be useful for controlling odors and mosquito proliferation. (Author's abstract)
W90-00571

ANAEROBIC FILTERS FOR MUNICIPAL WASTEWATER TREATMENT.
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, R. C. Landine, and S. R. Pyke.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 46, No. 1, p 71-76, 1989. 4 tab, 1 ref.

Descriptors: *Anaerobic filters, *Wastewater treatment, *Filtration, *Filter media, *Municipal wastewater, Flow system, Feedwater treatment, Effluents, Biological oxygen demand, Suspended solids, Anaerobic conditions.

A study was undertaken using anaerobic filters (both laboratory and pilot-scale) for municipal wastewater treatment in order to compare the performance of anaerobic filters in different flow modes (downflow and horizontal) using laboratory models; to compare the performance of anaerobic filters using different media (rock and wood) using laboratory models; and to compare the performance between laboratory-scale and pilot-scale anaerobic filters (downflow, rock medium). Four laboratory reactors (two downflow rock, one downflow wood, and one horizontal flow rock) were operated at 35-38 degrees C for an initial period of six months and later at 23-27 degrees C, with primary clarifier effluent (PCE) from a municipal wastewater treatment plant as the feed to the reactors. A pilot-scale rock medium reactor located at a municipal wastewater treatment plant was operated at 24-28 degrees C initially in the downflow mode and later at 18-20 degrees C in the upflow mode with PCE as feed. The laboratory study showed that PCE can be successfully treated using both downflow and horizontal flow anaerobic filters, with similar performance under both flow modes. Bench-scale filters obtained better biological oxygen demand and suspended solids removals compared to the pilot-scale filter. (Author's abstract)
W90-00626

STORM DRAIN DESIGN: DIFFUSIVE FLOOD ROUTING FOR PCS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 8A.
W90-00633

ANAEROBIC-AEROBIC TREATMENT OF DISTILLERY WASTES.
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
S. Shrihari, and V. Tare.
Water, Air, and Soil Pollution WAPLAC, Vol. 43, No. 1/2, p 95-108, January 1989. 6 fig, 2 tab, 12 ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Aerobic treatment, *Anaerobic digestion, Wastewater dilution, Chemical oxygen demand, Biological wastewater treatment, Effluents, Sludge solids.

Distillery industries are among the major pollutors of the aquatic environment. Waste generated from distilleries is highly organic in nature. An attempt has been made to find an efficient disposal method of distillery effluents through anaerobic followed by aerobic treatment. Accordingly, experimental studies were planned and carried out in two phases. The first phase of experimentation was conducted to study the performance of semicontinuous fixed film anaerobic reactors which simulate downflow stationary fixed film anaerobic reactors for partial treatment of distillery waste. The second phase of experimentation included studies on degradation of anaerobically treated effluent employing semicontinuous aerobic reactors with sludge recycle. The results indicated that the distillery waste should be diluted to bring down the chemical oxygen demand (COD) by circulating the treated effluent before it is treated by stationary fixed film anaerobic reactors. Further reduction of COD by anaerobic treatment appears to be uneconomical. Results of the second phase of the study show that the aerobic degradation of anaerobically treated effluent can achieve significant COD reduction (approximately 67%). The settling characteristics of the sludge produced in the aerobic study depended on the biological solids retention time (BSRT) value and improved with an increase in BSRT. (Author's abstract)
W90-00644

DESIGN OF WASTEWATER STORAGE PONDS AT LAND TREATMENT SITES. II: EQUILIBRIUM STORAGE PERFORMANCE FUNCTIONS.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W90-00655

EVALUATION OF ON-SITE WASTE DISPOSAL SYSTEM FOR NITROGEN REDUCTION.
Anne Arundel County Dept. of Health, Annapolis, MD.
For primary bibliographic entry see Field 5E.
W90-00656

USE OF TAILORED BENTONITE FOR SELECTIVE REMOVAL OF ORGANIC POLLUTANTS.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
F. Cadena.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 756-767, August 1989. 7 fig, 3 tab, 14 ref.

Descriptors: *Adsorption, *Organic wastes, *Bentonite, *Montmorillonite, *Aromatic compounds, *Water treatment, *Wastewater treatment, Ammonia, Clays, Separation techniques, Benzenes, Ion exchange, Hydrogen ion concentration.

Removal of organic contaminants from aqueous solutions by natural clays may be enhanced by tailoring the clay through a cationic exchange of the natural hydrophilic cations with lyophilic organic cations having lower hydrated radii. This possibility wsa investigated by exchanging the natural cation in Wyoming bentonite with tetramethylammonium (TMA+) ions. The adsorptive properties of TMA-bentonite increase in direct proportion to the exchange reaction below 60% of the CEC of the clay. The ability of the modified clay to remove benzene decreases at doses higher than 150% of the CEC of the clay. Adsorption isotherm constants on TMA-bentonite are calculated from equilibrium studies for benzene, toluene, and o-xylene. The selectivity of the TMA-tailored bentonite follows the following order: benzene >> toluene > o-xylene. Solute equilibrium concentration is attained within a five-minute contact time. Solution pH plays a secondary role in the adsorptive nature of TMA-bentonite. (Author's abstract)
W90-00658

MEMBRANE/OIL STRIPPING OF VOCS FROM WATER IN HOLLOW-FIBER CONTACTOR.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
A. K. Zander, R. Qin, and M. J. Semmens.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 768-784, August 1989. 13 fig, 2 tab, 25 ref, append.

Descriptors: *Water treatment, *Organic compounds, *Membrane processes, *Oil-water interfaces, *Separation techniques, Hazardous wastes, Wastewater treatment, Mass transfer, Design criteria.

Separation of volatile organic contaminants from water using a microporous hollow-fiber membrane/oil stripping system was evaluated. Countercurrent flow of water and oil on opposite sides of an air-filled gas-permeable membrane was used to concentrate the contaminants in the oil phase. The rate of mass transfer under varying conditions was measured and compared to existing full-, and laboratory-scale air-stripping processes, to membrane-extraction processes, and to predictions based on known empirical and theoretical correlations. The correlations can be used as the basis for system design and scale-up. This process incorporates the advantages of other membrane-stripping processes, such as a high surface area to volume ratio for transfer, and independent control of the separate liquid phases. It also overcomes several disadvantages of extraction and stripping processes. There is no contact between the liquid phases and thus no potential for cross-contamination or emulsion formation. The membrane separation of phases prevents flow channeling and flooding present in air-stripping towers. Finally, materials used in this process may be recovered and recycled, preventing further environmental contamination. (Author's abstract)
W90-00659

BREAKTHROUGH CURVES IN GRANULAR MEDIA FILTRATION.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
A. Adin, and R. Rajagopalan.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 785-798, August 1989. 5 fig, 10

ref, append.

Descriptors: *Water treatment, *Wastewater treatment, *Filtration, *Flocculation, *Filter media, *Mathematical models, *Deposition, Hydraulic conductivity, Colloids, Boundary conditions, Separation techniques, Theoretical analysis, Particle size, Soil types.

Experimental data show that the breakthrough curves observed in filtration in the case of both surface-force-dominated deposition and flocculation-dominated deposition display a general similarity. Some theoretical observations on these extreme cases of deposition behavior are presented which focus on the prediction of the breakthrough curves that could be expected in each case. Solutions for breakthrough curves are given, and their relationship to the deposition mechanisms and the corresponding boundary conditions is examined. The accumulation-detachment model is based on the fact that filtration is a process of accumulation where partial but continuous pore clogging takes place. Both cases involve similar theoretical and mathematical formulations and similar solutions. The pore-clogging model uses four easily determinable parameters: filter capacity, hydraulic conductivity, and accumulation and detachment coefficients. These are physically meaningful parameters, determining the volume of water that can be treated, the rate of clogging, and the flocculation efficiency. For a given water and filter bed, the two filtration coefficients depend on flocculant types and filtration rate. The coefficients can be used to evaluate flocculant performance. The smaller the detachment coefficient, the better the removal efficiency; however, the head loss develops faster. These predictive models are applicable to various waters, filter beds, flocculants, and soil types. They have a practical value in the design of new filters as well as in the upgrading of existing filters. (Geiger-PTT)
W90-00660

DEVELOPMENT AND DESIGN OF SLUDGE FREEZING BEDS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5E.
W90-00661

WATER STORAGE CAPACITY OF WETLAND USED FOR WASTEWATER TREATMENT.
George Mason Univ., Fairfax, VA. Dept. of Biology.
F. D. Heliotis.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 822-834, August 1989. 4 fig, 2 tab, 31 ref, append.

Descriptors: *Land treatment, *Wetlands, *Water storage, *Storage capacity, *Wastewater disposal, *Hydrologic models, *Wastewater treatment, Peat, Swamps, Water table, Rainfall, Specific yield, Nitrogen removal, Phosphorus removal, Design criteria.

Hydrologic considerations, such as the water storage capacity of peat, are critical in properly designing peatlands for wastewater treatment. Water storage capacity is estimated by measuring the specific yield of peat in a north Michigan cedar swamp. Field estimates of specific yield are performed by measuring the response of water table to rainfall. Specific yield, taken as the ratio of rainfall to water table rise, is found to decrease exponentially with depth, ranging between 0.4-0.7 for the surface layers and between 0.05-0.15 for peat layers at 0.5 m depth. A model predicting the water table response to rainfall is developed and successfully tested. Applications of the model in designing wetland wastewater treatment systems include computation of maximum wastewater quantity that can be sprinkled on a wetland before flooding and overland flow. Such information is critical in systems where optimum treatment is to be achieved when wastewater is absorbed into the peat matrix. (Author's abstract)
W90-00663

IMPROVEMENTS IN SOIL ABSORPTION TRENCH DESIGN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
B. E. Reed, M. R. Matsumoto, A. Wake, H. Iwamoto, and F. Takeda.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 853-857, August 1989. 3 fig, 6 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Land disposal, *Absorption, *Seepage, Capillarity, Aeration zone, Chemical oxygen demand, Organic matter.

The use of the capillary seepage trench (CST) for the treatment of wastewater was examined in laboratory tests. Soil collected from an agricultural field was placed into CST or conventional reactors and allowed to settle. A soluble synthetic wastewater with a COD of 1,000 milligrams/liter was applied at a rate of 67 liters/sq m of trench area/day for each reactor. Samples of the effluent were collected periodically over a 10-month period and analyzed for total COD. The COD concentrations were consistently lower in the CST as compared to the conventional system. Average effluent concentrations and standard deviation for the CST and conventional system were 10.3 +or- 2.5 milligrams/liter and 27.2 +or-11.0 milligrams/liter, respectively. CST provided significantly better removal of soluble organic matter than the conventional soil absorption system. The CST system produced a significantly better-quality during the winter/spring months. Hypothesized reasons for superior removal of organic matter in the CST compared with the conventional system are: flow path is longer in the CST due to capillary action drawing the wastewater upwards and horizontally instead of concentrating the flow under the trench as in the conventional system; and wastewater is more evenly distributed along the length of the trench in the CST system because the wastewater first collects in the impermeable trough, which is placed along the entire length of the trench, before it percolates downward through the soil matrix. (Geiger-PTT)
W90-00665

GET CONTROL OF YOUR ACTIVATED SLUDGE PROCESS.
Morrison Public Works Director, CO.
R. S. Jarski, H. M. Jean, and R. J. Neal.
Water Engineering and Management WENMD2, Vol. 136, No. 7, p 34-37, July 1989. 3 fig, 3 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Maintenance, *Process control, Aeration, Sludge solids, Bulking sludge, Monitoring, Sludge bed, Foaming, Dissolved oxygen.

Performing daily control tests such as microscopic and settleometer tests in combination with visual observations of the aeration and clarifier can help identify major upsets in an activated sludge process before they occur. A lack of surface turbulence in the aeration basin may indicate insufficient aeration. To ensure proper mixing, the operator should monitor dissolved oxygen concentrations and the quantity of air flow to the aeration basin on a regular basis and schedule proper maintenance and/or replacement of air diffusers at the bottom of the aeration basin and air filters on the compressed air blowers. When mechanical aerators are used, the operator should monitor the dissolved oxygen concentration within the aeration basin and measure the mixed liquor suspended solids concentrations throughout the basin. If an aeration basin surface is covered by thick white sudsy foam the sludge age is too young. A dense greasy layer of deep tan to brown-colored foam covering the basin surface indicates that the sludge is too old. Microscopic examination of the mixed liquor and foam should be performed to verify the presence of Nocardia filaments indicating the presence of old sludge. A light tan color and fresh musty odor of the mixed liquor is normally an indication of a young sludge. A dark brown to reddish brown color and stale musty odor of the mixed liquor is normally an indication of an old sludge. A dark grey or blackish color and sulfide odor of the mixed liquor indicates a septic sludge that is devoid of a healthy population of microorganisms. Sludge bulking is indicated by a homogeneous appearing sludge blanket extending across the clarifier. Proper monitoring and recording of blanket depth in the clarifier, settleometer tests and microscopic analyses can assist in identifying a potential bulking problem before it occurs. If filamentous bulking occurs, the operator can correct the problem on a short-term basis by chemical treatment. Clumping and ashing can be remedied by increasing the sludge-wasting rate and/or by increasing the return activated sludge rate. When straggler floc occurs, the operator should moderately reduce the sludge wasting rate to increase the sludge age. Pin floc can be minimized by increasing the wasting rate to reduce the sludge age or by reducing the air-flow rate to the aeration basin. (Geiger-PTT)
W90-00667

SPINNING AIR BLASTS OPERATING COSTS.
Dresser Industries, Inc., Connersville, IN. Roots Div.
R. H. Eshelman.
Water Engineering and Management WENMD2, Vol. 136, No. 7, p 38-40, July 1989. 2 fig, 1 tab.

Descriptors: *Wastewater treatment, *Aeration, *Hydraulic valves, *Hydraulic equipment, *Operating costs, Cost analysis, Electric power costs, Compressed air, Flow rates, Process control.

A simple and common energy conservation technique in wastewater treatment is to control compressor output (air pressure and flow) to meet the plant's immediate demand. Inlet guide vane technology is being applied on centrifugal compressors with inlet volumes as low as 4000 ACFM, a size range where butterfly valves have traditionally been used to modulate pressure and flow. Even on these smaller compressors, inlet guide vanes yield 5-11% higher energy cost reductions than butterfly valves. Electrically-driven centrifugal compressors typically operate at a constant speed and are designed to deliver a specified weight-flow of air to the aeration system under the worst anticipated environmental conditions. Plant conditions also contribute to the compressor's operation. A pressure drop across the diffusers will increase as the diffusers clog up affecting the compressor discharge pressure. The air distribution piping creates frictional losses. Since the compressor is almost always operating at a discharge pressure and flow lower than it was designed to generate, inlet control devices (inlet guide vanes and butterfly valves) enable a plant operator to adjust the compressor output to these changing conditions, reducing horsepower demand and operating costs. A butterfly valve in the inlet line to the compressor can control discharge pressure, inlet volume, or both. The butterfly valve creates a pressure drop at the inlet, though, which prevents the compressor from producing its design discharge pressure. As it begins to close, the butterfly valve restricts air flow so that the inlet pressure drops downstream of the valve, which ultimately reduces the discharge pressure. Inlet guide vanes operate on a different principle actually reducing adiabatic head by spinning the flow of incoming air into the impeller at high velocity. Inlet guide vanes for pressure and flow control are located immediately in front of the compressor impeller. When fully open, the vanes allow air to pass straight into the impeller so the compressor operates at design pressure and flow. As the vanes are closed to reduce discharge pressure or flow, they turn the incoming air in the direction of the impeller's rotation. This pre-rotation of the air substantially reduces the amount of power the compressor's impeller needs to maintain the desired pressure and flow. A butterfly valve, by way of contrast, reduces inlet pressure to reduce discharge pressure, but does not change the head. (Geiger-PTT)
W90-00668

STABLE N-CHLOROALDIMINES AND OTHER PRODUCTS OF THE CHLORINATION OF ISOLEUCINE IN MODEL SOLUTIONS AND IN A WASTEWATER.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.

A. Nweke, and F. E. Scully.
Environmental Science and Technology ESTHAG, Vol. 23, No. 8, p 989-994, August 1989. 5 fig, 1 tab, 43 ref. NSF Grant ECE-8415255.

Descriptors: *Water pollution sources, *Chlorinated hydrocarbons, *Wastewater treatment, *Wastewater oxidation, *Isoleucine, *Chlorination, Spectroscopy, Amino acids, High performance liquid chromatography.

Solutions of the amino acid isoleucine were chlorinated to different chlorine to nitrogen mole ratios and analyzed by ultraviolet spectroscopy, gas chromatography, and high performance liquid chromatography (HPLC). The mono-N-chlorinated amino acid, 2-methylbutyraldehyde, and 2-methylbutyronitrile were products, the yields of which varied with chlorination level. At Cl/N mole ratios greater than two a previously undetected N-chlorinated aldimine, which was remarkably stable in the absence of ammonia, was the main product. The concentration of isoleucine in an unchlorinated primary municipal wastewater effluent was determined. The products of its chlorination and their yields at different Cl/N ratios were determined by using a radiotracer and were found to be similar to those observed in model solutions. A scheme of pathways for the formation of the various products from the chlorination of isoleucine is proposed. This work suggests that N-chloraldimines may contribute significantly to a stable combined oxidant concentration in wastewaters chlorinated to a free residual. (Author's abstract)
W90-00688

PRACTICAL PERFORMANCE OF VARIOUS SYSTEMS FOR SMALL-SCALE WASTEWATER TREATMENT DURING A TWO-YEAR FIELD TEST.
Witteveen and Bos, Deventer (Netherlands).
J. H. van der Graaf, F. A. Fastenau, and A. H. M. van Bergen.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 1-12, July 18 1989. 5 fig, 5 tab, 2 ref.

Descriptors: *On-site wastewater treatment, *Domestic wastes, *Wastewater treatment, Performance evaluation, Comparison studies, The Netherlands.

Diffuse pollution, caused by direct discharges from individual houses or groups of houses for which connection of central wastewater treatment systems is not feasible, may be significantly reduced by on-site treatment. The performances of 14 different systems for on-site treatment in the range of 5-200 population equivalents (p.e.) in the Netherlands were tested over a two-year period of field research. Treatment results showed reasonably comparable removal percentages in relation to large systems, though the effluent quality may not be as good due to higher influent concentrations. Significant differences in treatment, operation and maintenance aspects were recorded, causing some systems to be preferred to others. The feasibility of wide-spread application of small treatment plants may depend more on financial, management and organizational aspects than on technological aspects. It is shown that a pre-treatment tank of considerable size (0.3 to 1.5 cu m/p.e.) plays an important role in small treatment systems. Of simple design, well adapted for on-site treatment, this tank offers primary treatment, equalization of the wide variation in inflow characteristics, protection of the secondary treatment against disturbing impacts, and storage volume for sludge and scum, all at low cost. (Friedmann-PTT)
W90-00746

DIMENSIONS OF AERATED GRIT CHAMBERS AND USE AS A HIGHLY LOADED ACTIVATED SLUDGE PROCESS.
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
J. Londong.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 13-22, July 18 1989. 7 fig, 2 tab, 15 ref.

Descriptors: *Grit chambers, *Wastewater treatment, *Aeration, *Activated sludge process, *Stage treatment, Activated sludge, Sludge, Wastewater.

The aerated grit chamber has long been used to separate sand from sewage. Nevertheless, there are no definite and uniform recommendations for dimensioning, and there is little information in the literature about the degree of separation attainable. Thus, principles for dimensioning and the possible degree of separation are derived from measurements of large pilot scale plants, two-dimensional models, and existing aerated grit chambers. The following values for dimensioning were found in this work: a detention period of about 20 minutes; a width to depth ratio (w/d) of about 0.8; a minimal and maximal cross section area between 1 and about 7 sq m; a flow velocity of 20 cm/s at the bottom of the aerated grit chamber. Simple formulas for the determination of the required amount of air can be given in relation to the w/d ratio, the depth of air injection and the kind of aeration used (fine or coarse bubble). The simultaneous use of an aerated grit chamber as an adsorption stage (highly loaded activated sludge process) is possible without additional air being required to maintain the velocity at the bottom of the grit chamber. for purely aerobic operation, however, the amount of air has to be increased. (Author's abstract)
W90-00747

POST TREATMENT OF ANAEROBIC EFFLUENT USING SEQUENCING BATCH REACTORS.
National Univ. of Singapore. Dept. of Civil Engineering.
K. K. Chin.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 23-28, July 18 1989. 3 fig, 3 tab, 4 ref.

Descriptors: *Food-processing wastes, *Wastewater treatment, *Oil wastes, *Oil, *Anaerobic digestion, Organic wastes, Chemical oxygen demand, Wastewater, Anaerobic conditions.

Edible oil refineries generate a large quantity of wastewater. Characteristics of these wastewaters vary significantly from day to day and from plant to plant depending on processes used in refining the crude oil to the types of products and market demands. The performance of the Sequencing Batch Reactors (SBRs) as a polishing process for the effluent of attached film anaerobic reactors was evaluated for treatment of edible oil refinery wastewaters under the variable hydraulic and organic loadings. A 150 l filed unit and two 7.5 l laboratory SBRs were used to polish edible oil refinery wastewater pretreated by attached film anaerobic reactors. SBRs performed well with respect to Chemical Oxygen Demand (COD) and suspended solids removal. At a loading rate of less than 2 kg COD/cu m-d, more than 90% COD removal efficiency was achieved. Solids settling was good with SV1 generally less than 160. The system showed stability under large variations of organic loading and operating conditions. A significant amount of COD was removed during the long filling and anoxic period. (Friedmann-PTT)
W90-00748

INCIDENCE OF SPHAEROTILUS NATANS IN LABORATORY SCALE ACTIVATED SLUDGE SYSTEMS.
California Univ., Berkeley. Dept. of Civil Engineering.
D. M. D. Gabb, G. A. Ekama, D. Jenkins, and G. R. Marais.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 29-41, July 18 1989. 2 fig, 3 tab, 45 ref.

Descriptors: *Sphaerotilus, *Activated sludge process, *Bulking sludge, *Wastewater treatment, Activated sludge, Bacteria, Mixed liquor solids, Microorganisms.

Bulking in activated sludge systems due to proliferation of Sphaerotilus natans is very common in laboratory-scale but rare in full-scale systems. From two laboratory-scale studies, it is concluded that a cause for proliferation was attached growth of S. natans on the walls of the feed lines and reactor surfaces continuously seeding the mixed liquor. It is suggested that S. natans bulking in laboratory-scale systems is common compared to full-scale systems because the surface area/volume ratio of the former is orders of magnitude higher than that of the latter so that the potential for seeding from attached growths in laboratory-scale plants is correspondingly higher. It would appear that in laboratory-scale activated sludge systems, regular cleaning of the feed lines and daily scrubbing of the reactor and other wetted surfaces will eliminate S. natans bulking due to seeding of the mixed liquor from these surfaces. (Author's abstract)
W90-00749

DIRECT SOLID-LIQUID SEPARATION USING HOLLOW FIBER MEMBRANE IN AN ACTIVATED SLUDGE AERATION TANK.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
K. Yamamoto, M. Hiasa, T. Mahmood, and T. Matsuo.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 43-54, July 18 1989. 8 fig, 6 tab, 17 ref.

Descriptors: *Separation techniques, *Wastewater treatment, *Activated sludge process, *Semipermeable membranes, *Membrane filters, Membrane processes, Organic wastes, Activated sludge, Aerobic conditions, Aerobic digestion.

Direct membrane separation using hollow fibers was applied to wastewater treatment in an activated sludge process. A membrane module with a pore size of 0.1 microns was immersed in the aeration tank and treated water was filtered through the membrane by suction. Various operational modes were applied to investigate stable flux conditions as well as organic and nitrogen removal. The stable treatment with a detention time of 4 hours could be kept for about 120 days at a volumetric organic loading of 1.5 kg COD/cu m-day using intermittent suction with a low pressure of 13 kPa (1.3 m as water head). The COD removal was higher than 95% and more than 90% of COD supplied was oxidized to keep MLSS almost constant in the reactor without sludge wastage, which suggests that total oxidation of influent biodegradable materials can be achieved in this system. Up to 60% of nitrogen could be denitrified by intermittent aeration. The critical organic loading was estimated as 3 to 4 kg COD/cu m-day in order to keep both stable flux and aerobic conditions. The clogging in the membrane was inevitable to some extent, however, the intermittent suction and low pressure operation without cleaning could prevent the unrecoverable clogging and dead end of operation. (Author's abstract)
W90-00750

METHANOGENIC DEGRADATION OF PHENOL AND BENZOATE IN ACCLIMATED SLUDGES.
Mitsubishi Electric Corp., Amagasaki (Japan). Product Development Lab.
T. Kobayashi, T. Hashinaga, E. Mikami, and T. Suzuki.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 55-65, July 18 1989. 7 fig, 2 tab, 7 ref.

Descriptors: *Sludge conditioning, *Wastewater treatment, *Anaerobic digestion, *Anaerobic conditions, *Biodegradation, Sludge, Chemical degradation, Methanogenesis, Phenols, Benzoates.

Anaerobic phenol and benzoate degrading consortia were cultivated by acclimation of methanogenic sludges to be capable of degrading completely to CO2 and CH4 1,000 g/l of phenol within 5-7 days, and 3,000 mg/l of benzoate within 5-7 days, respectively. By using the acclimated sludges, the effect of gaseous atmospheres (H2:CO2/80:20 and N2:CO2/80:20) on the biodegradability and the degradation pathways of phenol and benzoate were examined. Although the anaerobic degradation of phenol was accelerated in the H2/CO2 atmosphere compared with the N2/CO2 atmosphere, benzoate was accumulated. Degradations of

benzoate and butyrate were inhibited in the N2/CO2 atmosphere under stirred conditions, but not under static conditions. Through a series of biodegradation tests by using several intermediates in phenol degradation reported previously, the anaerobic degradation pathway of phenol in the N2/CO2 atmosphere was suggested to be phenol--benzoate--cyclohexane carboxylate (or 1-cyclohexene carboxylate)--fatty acids--CO2,CH4. (Author's abstract)
W90-00751

CYANIDE TRANSFORMATION IN ANAEROBIC PHENOL-DEGRADING METHANOGENIC CULTURES.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Fedorak, and S. E. Hrudey.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 67-76, July 18 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Biodegradation, *Detoxification, *Wastewater treatment, *Industrial wastewater, *Methane, *Cyanide, *Anaerobic conditions, *Culturing techniques, Chemical reactions, Phenols.

Cyanide, which is inhibitory to methanogenesis, is a common toxic contaminant in a variety to industrial wastewaters. Among these are coal conversion and coking wastewaters that contain phenolics that are amenable to biodegradation by methanogenic consortia. Semicontinuous anaerobic phenol-degrading cultures were exposed to a range of total cyanide concentrations from 5 to 30 mg/l (free cyanide from 0 to 18 mg/l) for a 140-day period. The higher cyanide concentrations gave longer lag periods before the onset of methane production. After methanogenesis became established, the rate of methane production in cyanide-fed cultures matched that of the cyanide-free controls. In batch cultures, free cyanide was substantially removed before the onset of methanogenesis. Addition of 14CN(-) to a semicontinuous culture demonstrated that the majority of the label was transformed to a product that remained in the liquid phase. Although the product has not been identified, thin layer chromatography analysis has shown that it is not one of the following detoxification products reported for aerobic biological systems: thiocyanate, beta-cyanoalanine, valine, alanine, aspartate or asparagine; nor is the product ferrocyanide or a cobalt complex. These studies have shown that methanogenic consortia can detoxify cyanide while they continue to degrade phenol. (Author's abstract)
W90-00752

ANAEROBIC FIXED BED REACTOR WITH A POROUS CERAMIC CARRIER.
NGK Insulators Ltd., Handa (Japan). Research and Development Lab.
M. Kawase, T. Nomura, and T. Majima.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 77-86, July 18 1989. 7 fig, 5 tab, 10 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Microbial degradation, *Biodegradation, Anaerobic conditions, Contact beds, Thermophilic bacteria, Chemical oxygen demand, Anaerobic bacteria.

To date, a large number of studies on anaerobic fixed bed reactors have been reported, but there have been few studies on the application of this technology to thermophilic anaerobic treatment. One of the reasons for the small number of applications is the difficulty of attaching thermophilic anaerobic organisms to carriers. The thermophilic treatment performance of an anaerobic fixed bed reactor, containing a porous ceramic carrier ('microbe immobilized ceramic,' MIC), developed for the immobilization of anaerobic organisms, was examined. When boiled soybean wastewater (55,000 mg/l COD) was treated anaerobically at a high temperature (54 C) in reactor where 31% of the volume was filled with the MIC carrier, it was found that highly loaded operation with up to 65 kg COD/cu m/d was possible. The COD load per unit area of carrier surface under these operational conditions reached 0.397 kg COD/sq m/d, and the performance of the reactor was excellent. Stable anaerobic treatment was achieved when the COD loading rate fluctuated from 26 to 51 kg COD/cu m/d. (Author's abstract)
W90-00753

VACUUM OPERATION FOR OVERLOADED ANAEROBIC TREATMENT SYSTEMS.
Syracuse Univ., NY. Dept. of Civil Engineering.
J. De Santis, and A. A. Friedman.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 87-95, July 18 1989. 5 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Vacuum filtration, Organic wastes, Fatty acids, Anaerobic conditions.

Overloaded anaerobic treatment systems are characterized by high concentrations of volatile fatty acids and molecular hydrogen and by poor conversion of primary substrates to methane. Previous experiments with fixed-film reactors indicated that operation with reduced headspace pressures enhanced anaerobic treatment. For these studies, four suspended culture, anaerobic reactors were operated with headspace pressures maintained between 0.5 and 1.0 atm and a solids retention time of 15 days. For lightly loaded systems (0.4 g SCOD/g VSS-day) vacuum operation provided minor treatment improvements. For shock organic loads, vacuum operation proved to be more stable and to support quicker recovery from upset conditions. Based on these studies and a companion set of bioassay tests, it is concluded that: (1) a loading rate of about 1.0 g SCOD/g VSS-day represents a practical loading limit for successful anaerobic treatment, (2) a headspace pressure of approximately 0.75 atm appears to be an optimum operating pressure for anaerobic systems, and (3) simple modification of existing systems may provide relief for organically overloaded systems. (Author's abstract)
W90-00754

EFFECTS OF THERMAL PRETREATMENT OF SEWAGE SLUDGE ON ANAEROBIC DIGESTION.
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
J. Pinnekamp.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 97-108, July 18 1989. 9 fig, 1 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Digested sludge, *Heat treatment, Wastewater, Energy, Temperature effects, Sludge, Anaerobic conditions, Heated water.

The constraints on thermal pretreatment of sludge at temperatures in excess of 100 C, and its effects on subsequent anaerobic digestion, are examined. Maximum measured increase rates and the corresponding optimum pretreatment temperatures, as a function of the type of sludge tested, were determined. These rates ranged from +269.2% for digested sludge to 0.5% for excess sludge SLR=0.60, while optimum pretreatment temperatures ranged from 180 C for digested sludge down to 135 C for excess sludge SLR=0.60. Calculation of detailed energy balances for various sludge treatment systems with and without thermal pretreatment revealed a clear economic advantage for thermal pretreatment. The excess heat for an overall system composed of thermal pretreatment, anaerobic stabilization and digester-gas electricity generation is significantly higher than that for a system without pretreatmetn. sludge pasteurization represents an additional advantage of thermal pretreatment. High temperature conditioning of sewage sludge utilized the breakdown of cell structure to improve dewaterability. Thermal conditioning released internal cell water in addition to adsorption, interstitial and capillary water, since the cell structure was destroyed. Thermal pretreatment caused hydrolysis of sludge constituents, which become accessible only through biological degradation. However, according to the results of this study, a reverse effect occurs at temperatures over about 180 C. Despite increased thermal dissolution, gas production decreased sharply, in some cases to a value below that of the control sludge. This phenomenon may be ascribed to reaction of low sugars contained in the sludge with amino acids, forming compounds that are difficult to degrade. In general, it was determined that, provided certain conditions are satisfied, thermal pretreatment of sewage sludge prior to anaerobic stabilization can positively affect the energy balance of the treatment plant. (Friedmann-PTT)
W90-00755

GRANULAR SLUDGE FORMATION IN THE ANAEROBIC EXPANDED MICROCARRIER BED PROCESS.
Kurita Water Industries Ltd., Atsugi (Japan).
M. Yoda, M. Kitagawa, and Y. Miyaji.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 109-120, July 18 1989. 13 fig, 4 tab, 12 ref.

Descriptors: *Wastewater treatment, *Contact beds, *Sludge digestion, *Anaerobic digestion, *Activated sludge process, Wastewater analysis, Anaerobic conditions, Methane bacteria.

The mechanisms of granular sludge formation in microcarrier bed (MCB) reactors were investigated, with the role of the microcarrier and the influence of substrate type on the granulation process being of special interest. An MCB reactor with a total reactor volume of 800 to 1 was operated to demonstrate granular sludge formation and reactor performance in a large scale experiment. The anaerobic MCB process, which utilized fine (50-100 micron) support materials as expanded bed media, was found to have the ability to cultivate granular sludge similar to that formed in the upflow anaerobic sludge blanket (UASB) process. Thus, the granular sludge formation in MCB reactors may be considered as a biofilm forming phenomenon. Dense biofilms were formed with a VFA substrate, resulting in extremely high biomass concentrations over 50 kgVSS/cu m, though two macroscopically different types of sludge were observed. The syntrophic relationship between acetogenic and methanogenic bacteria may play a key role in forming a dense biofilm. Though all the microcarrier was transformed to granular sludge with glucose wastewater, explosive growth of fluffy filamentous sludge occurred when unacidified wastewater was fed. Pre-acidification of sugar-containing wastes proved to be effective in depressing excessive acidogenic bacteria and, therefore, in forming and maintaining the dense structure of granular sludge. (Friedmann-PTT)
W90-00756

SLUDGE CHARACTER AND ROLE OF SULFATE IN A UASB SYSTEM TREATING A PAPER PLANT EFFLUENT.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
S. L. Russo, and P. L. Dold.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 121-132, July 18 1989. 7 fig, 1 tab, 7 ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Pulp and paper industry, *Sludge digestion, *Anaerobic digestion, *Sulfates, *Contact beds, Kraft mills, Effluents, Substrates, Sludge, Sludge seeding, Chemical oxygen demand.

Relatively few investigations into anaerobic treatment of wastes from the pulp and paper industry have been reported. The upflow anaerobic sludge bed (UASB) reactor is one of the systems currently receiving attention in the pulp and paper industry. Effluent from a paper plant (4500 mg COD/l; 250 mg SO4(2-)/l) was treated in 9 liter laboratory scale UASB reactors operated at 25 C and 35 C. COD removals of 85% were attained in both reactors at loading rates of 26 kg COD/cu m-d. This treatability study conducted on wastewater from a waste paper re-pulping plant provided information on a wide range of factors. Observations on concentration changes through the reactor from inlet to outlet yielded interesting information in terms of

the hypothesis on sludge pellet formation postulated earlier. Only limited pelletization is likely with this waste because a high H2 partial pressure zone is not created at the base of the reactor: the influent substrate available for acidogenesis, with its associated H2 production, is limited; rapid-growing organisms utilize H2 at the reactor inlet. A dense bed of biological sludge extended from the base to approximately half the height of the UASB reactors. This sludge had a granular, well-flocculated form with the flocs appearing to be in the size range of 1-2 mm. Very fine sludge was also present within the bed. A small number of true sludge pellets (4-5 mm) were present within the dense sludge bed, particularly near the base. During the study, the 35 C UASB reactor was re-started after standing at 20 C without feed for a period of 2 months. Within a period of 10 days, the load on the reactor could be reinstated and COD removals in excess of 80% were attained. (Friedmann-PTT)
W90-00757

TREATMENT OF LANDFILL LEACHATE WITH AN UPFLOW ANAEROBIC REACTOR COMBINING A SLUDGE BED AND A FILTER.
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5G.
W90-00758

CHARACTERIZATION, DIGESTIBILITY AND ANAEROBIC TREATMENT OF LEACHATES FROM OLD AND YOUNG LANDFILLS.
Santiago Univ. (Spain). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5G.
W90-00759

INFLUENCE OF SEEDING CONDITIONS ON INITIAL BIOFILM DEVELOPMENT DURING THE START-UP OF ANAEROBIC FLUIDIZED BED REACTORS.
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
F. Ehlinger, M. M. Audic, and G. M. Faup.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 157-165, July 18 1989. 9 fig, 3 tab, 22 ref.

Descriptors: *Biofilms, *Wastewater treatment, *Anaerobic digestion, *Sludge seeding, *Contact beds, *Fluidized bed process, *Biological wastewater treatment, Biomass, Anaerobic conditions, Industrial wastes.

Anaerobic digestion is now a very common process for the treatment of industrial and urban wastewater. However, during plant star-ups, there are many technical problems, such as very slow increases of the load with risks of inhibition of the activity of the biomass. Significant information was sought about the difficult stage of initial adhesion of the biomass and the subsequent development of the biofilm. The first experiment permitted the study of the composition of the biofilm and the evolution of its specific activity in the first weeks after start-up. The second experiment showed the disturbance due to the pH during this period. The characterization of the biofilm of an anaerobic fluidized bed reactor was completed under standard conditions. The distribution of the fixed protein concentration depended on the level in the reactor. The protein concentration reached 1520 micrograms/g of support at the top of the reactor and only 1200 micrograms/g at the bottom after 504 h of operation, but the specific activity of the biofilm was 0.00033 microns acetate/h-mg proteins at the bottom and only 0.00026 microns/h-mg at the top. The efficiency of a fluidized bed reactor and the composition of the biofilm changed with an increase of the pH from 7 to 8.5 during the seeding of the support material. Future development of the biofilm and the specific activity of the support were affected. It is concluded that the seeding period and the star-up period are critical phases resulting in physiological stress of the biomass. Nevertheless, the most important target is to develop the most active biofilm possible. (Friedmann-PTT)
W90-00760

OPERATIONAL CONTROL OF AN ANAEROBIC GAC REACTOR TREATING HAZARDOUS WASTES.
Illinois Univ., Urbana. Dept. of Civil Engineering.
G. F. Nakhla, M. T. Suidan, and J. T. Pfeffer.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 167-173, July 18 1989. 5 fig, 3 tab, 8 ref. US DOE Grant DE-AC21-80MC14713.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Hazardous materials, *Activated carbon, *Toxicity, *Wastewater, Anaerobic conditions, Chemical oxygen demand, Hydraulic engineering.

An expanded-bed granular activated carbon (GAC) anaerobic reactor was employed to investigate the effect of empty bed detention time, sludge age, and chemical oxygen demand (COD) loading on process performance during the treatment of a coal conversion wastewater. The toxicity of the wastewater to the anaerobic culture was overcome by periodic partial replacement of the reactor medium with fresh GAC. The first phase of this study determined the minimum GAC replacement rate required to successfully treat the wastewater at a COD loading of 11 g-COD/kg-GAC-day. The second phase investigated the dependence of the system performance on hydraulic retention time and the volumetric COD loading rate. Very high organic removal efficiencies, as well as approximately 50% conversion of the influent COD to methane gas were achieved even at empty-bed hydraulic retention times as low as 7 hrs. (Author's abstract)
W90-00761

KINETIC STUDY ON THE METHANOGENESIS PROCESS IN ANAEROBIC DIGESTION.
Feng Chia Univ., Taichung (Taiwan). Dept. of Hydraulic Engineering.
C. Y. Lin, T. Noike, H. Furumai, and J. Matsumoto.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 175-186, July 18 1989. 4 fig, 5 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Methane, *Chemical treatment, Kinetics, Chemical reactions, Fatty acids, Anaerobic conditions, Substrates.

A two-phase digestion process has been suggested recently to improve anaerobic treatment efficiency with a shorter digestion time that satisfies both increased waste volume and lower investment requirements. To develop this new waste treatment technology, an understanding of the process kinetics is necessary. The Rapid rate of methanogenesis in a two-phase anaerobic digestion is proved kinetically, and a method for the kinetic analysis is suggested. A mixture of the major intermediate products of anaerobic digestion, i.e., HAc, HPr, and HBu was used as the carbon source in methanogenic experiments to obtain kinetic constants for mixed VFA, and a batch experiment was also conducted to obtain substrate utilization rates for each of the VFA in the mixture. The methanogenic experiments, which used high concentrations of a mixture of acetic, propionic and butyric acids, showed that the kinetic mechanism of the methanogenesis process using a mixture of volatile fatty acids can be described by a Michaelis-Menten equation. The rapid rate of methanogenesis in a two-phase anaerobic digestion can be proved kinetically. The conversion of acetate into methane, which is the rate-limiting step of the methanogenesis process, has a specific rate value of 18.8 l/day, which is three times faster in the digester fed with a mixture of volatile fatty acids. The effluent substrate concentration in a methanogenic digester fed with a multisubstrate can be predicted from the influent component substrates. (Friedmann-PTT)
W90-00762

PATTERNS OF HYDROGEN IN BIOGAS FROM THE ANAEROBIC DIGESTION OF MILK-SUGARS.
Water Research Centre, Stevenage (England).
F. E. Mosey, and X. A. Fernandes.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 187-196, July 18 1989. 6 fig, 16 ref.

Descriptors: *Hydrogen, *Biogas, *Milk, *Wastewater treatment, *Anaerobic digestion, *Methane bacteria, *Biological wastewater treatment, *Fermentation, Substrates, Anaerobic conditions, Methane.

The saturation constant for uptake of hydrogen by methanogens, in anaerobic digestion is around 6000 vpm H2 in the gas. Methane bacteria in anaerobic digesters can rapidly metabolize any surplus hydrogen and any peaks of hydrogen in the biogas following surge loads are likely to be brief, transient phenomena, acting more as event-markers than as a long-term loading index. To monitor and record these transient peaks of hydrogen, a small, laboratory-scale anaerobic digester was equipped with instrumentation for on-line monitoring of pH value, gas flow and of concentrations of methane and hydrogen in the biogas and fed with a synthetic substrate comprising a 70 g/l solution of reconstituted skimmed milk powder. The concentrations of hydrogen were monitored intensively to determine whether hydrogen could provide a useful new alarm/loading indicator for the anaerobic digestion process. With fast-fermenting substrates such as milk sugars, it proved to be a very sensitive event-marker, producing small ripples in time with operation of the digester feed pump as well as larger pulses caused by chloroform toxicity. Scavenging of hydrogen by lithotropic methanogens appeared to promote the fermentation of sugars directly to acetate, bypassing both the formation and subsequent breakdown of higher acids, a feature that is likely to prove peculiar to methanogenic and sulfate-reducing fermentations. (Friedmann-PTT)
W90-00763

FULL-SCALE STUDIES WITH AN ANAEROBIC/AEROBIC RBC UNIT TREATING BREWERY WASTEWATER.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. J. Ware, and M. B. Pescod.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 197-208, July 18 1989. 4 fig, 1 tab, 7 ref.

Descriptors: *Food-processing wastes, *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, *Aerobic digestion, Biofilms, Industrial wastes, Chemical oxygen demand, Anaerobic conditions.

It it well established that anaerobic treatment of high strength industrial wastewaters can be competitive with conventional aerobic treatment processes. The aerobic rotating biological contactor (RBC) has become increasingly popular as a small-scale wastewater treatment plant because of its easy maintenance, low sludge production and lower power requirements. For the first time, a full-scale combined anaerobic random packed-cage and aerobic disc RBC was operated under fluctuating organic loading rates treating a brewery wastewater. Flow conditions in the anaerobic unit were arbitrary at 1 cu m/h tending toward completely mixed at lower flow rates. The influent wastewater COD was variable between 1900 and 8500 mg/l as was the pH, between 6.5 and 12.1. The maximum sustained flow rate applied to the aerobic unit was 0.33 cu m/cu m-d and the maximum sustained organic loading rate was 14.4 g COD/sq m-d (1.2 kg/cu m-d). No significant biofilm was detected on the outer layer of media in the cage and suspended solids levels only averaged 3500 mg/l during the study. Robustness of the combined system coping with greatly fluctuating influent COD's and pH's was shown. Excessive turbulence along with the variable operating conditions were identified as the major reasons for the failure to establish a significant anaerobic biofilm attached to the media. The importance os suspended sludge and its retention within the anaerobic RBC was demonstrated by the changing biological population in the suspended solids. Aerobic operation of the packed-cage prior to the establishment of anaerobic conditions is recommended as a possible method of increasing biofilm attachment rates

by providing a biological base to which to attach. (Friedmann-PTT)
W90-00764

FUNGAL PURIFICATION OF AN INDUSTRIAL EFFLUENT CONTAINING VOLATILE FATTY ACIDS BY MEANS OF A CROSSFLOW-MICROSCREEN TECHNIQUE.
Pretoria Univ. (South Africa). Dept. of Water Utilisation Engineering.
A. L. Kuhn, and W. A. Pretorius.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 221-229, July 18 1989. 9 fig, 3 tab, 20 ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Fatty acids, *Fungi, *Wastewater disposal, *Filtration, *Microbial degradation, Biological wastewater treatment, Biodegradation, Coal gasification, Effluents, Biomass, Growth kinetics.

Sasol produces fuels and chemicals from coal. Coal gasification followed by a variation of the Fischer-Tropsch synthesis process generates an effluent containing C2 to C5 monocarboxylic acids as well as small amounts of alcohols, ketones and hydrocarbons. A study was conducted to determine whether a crossflow-microscreen would select and maintain a stable and easily harvestable microbial culture from the Sasol effluent, to ascertain whether the selected microbial culture could remove the bulk of the organic loading and produce an effluent that could be reused or be safely disposed of, and to assess the kinetic parameters of the selected microbial culture. An industrial effluent containing C2 to C5 monocarboxylic acid was successfully treated by the fungus Geotreichum candidum using the selective mechanism of the crossflow-microscreen method. Due to the cell separating capacity of the microscreen, the system could be operated as a cell recycle reactor with the hydraulic residence time independent of the mean cell residence time. At a residence time of 1.25 h and mean cell residence time of 7.5 h, 89.5% COD reduction was obtained. The excess biomass could be harvested by simple screening and contained a crude protein content of 50.5%, which may be used as a feed supplement. The growth kinetic values obtained for a monoculture of G. candidum growtn on the industrial effluent were as follows: max. specific growth rate 0.26/h, yield coefficient 0.38 cells/g COD, substrate saturation coefficient 201 mg COD/l, and death rate coefficient .009/h, indicating the potential use of this microorganism for the treatment of several industrial effluents. (Friedmann-PTT)
W90-00766

SEASONAL AND IN-MILL ASPECTS OF ORGANIC HALIDE REMOVAL BY AN AERATED STABILIZATION BASIN TREATING A KRAFT MILL WASTEWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
C. W. Bryant, and G. L. Amy.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 231-239, July 18 1989. 1 fig, 2 tab, 23 ref.

Descriptors: *Stabilization lagoons, *Wastewater treatment, *Pulp wastes, *Kraft mills, *Aeration, *Organic compounds, *Biochemical oxygen demand, *Suspended solids, Pulp and paper industry, Halides, Carbon.

Many pulp and paper mills in the U.S. and Scandinavia employ aerated stabilization basins (ASBs) for the removal of biochemical oxygen demand, suspended solids, and nitrogenous compounds. An ASB with five sampling points was studied to determine seasonal variations of total organic halide (TOX) and total organic carbon (TOC) distribution, to define the major mechanism of organic halide removal in operating ASBs. The influence of in-mill production activities on levels and removal of organic halide was determined. Levels of TOX in the kraft mill wastewater ranged from 26,000 to 60,000 micrograms/l. The ASB proved capable of removing one-third to one-half of both the total TOX as well as lower molecular weight (< 1,000) TOX. Influent TOX levels varied as a function of in-mill production activities. Removal of specific size fractions of organic halide were influenced to different extents by influent variations and seasonal effects. The major removal mechanism appears to be biosorption of TOX onto settling biomass, followed by anaerobic dehalogenation within the benthal layer of the ASB. (Friedmann-PTT)
W90-00767

KRAFT LIGNIN BEHAVIOR IN DIFFUSED AERATION OF KRAFT EFFLUENTS.
Centro de Estudios e Investigaciones Tecnicas de Guipuzcoa, San Sebastian (Spain). Dept. of Environmental Studies.
L. Larrea, C. F. Forster, and D. Mele.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 241-253, July 18 1989. 10 fig, 3 tab, 23 ref.

Descriptors: *Pulp and paper industry, *Lignin, *Kraft mills, *Pulp wastes, *Aeration, *Chemical oxygen demand, *Wastewater treatment, Wastewater, Industrial wastes.

Diffused aeration experiments carried out using a kraft black liquor in batch reactors at 21 + 1 C were performed to characterize the relative importance of the mechanisms of chemical oxidation and condensation of lignin structures upon COD, lignin and color removal and also to evaluate the influence of agitation intensity on these mechanisms. It was found that total COD decreased with time. This behavior was independent of the aeration intensity and the reduction reached a value of about 18% of the initial COD after approximately 15 days. This reduction was attributed to chemical oxidation of some functional groups of the draft lignin contained in the substrate. However, filterable lignin (as absorbance at 272 nm) and color (as absorbance at 465 nm) were not affected by chemical oxidation. It was also observed that agitation produced the formation of suspended solids by condensation of lignin structures. This took place during the first 2 days and provoked a reduction of filterable COD, lignin and color, which was dependent on the aeration intensity. (Author's abstract)
W90-00768

WASTEWATER MANAGEMENT IN THE AUTOMOBILE INDUSTRY.
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
F. A. El-Gohary, S. I. Abo-ElEla, and H. I. Ali.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 255-263, July 18 1989. 6 fig, 4 tab, 6 ref.

Descriptors: *Wastewater treatment, *Wastewater management, *Automotive industry, *Industrial wastes, *Chemical wastewater, Inorganic compounds, Monitoring, Effluents, Heavy metals, Oil wastes, Cyanide.

Wastewater from the automotive industry is one of the major sources of heavy metals, cyanide, oil and grease, and organic and inorganic pollutants that contribute greatly to the pollution load of receiving water bodies, especially streams. An intensive monitoring program was conducted for nearly four months to study the management of wastewater discharged from this industry. Separate treatment of cyanide-bearing wastes, end-of-pipe effluent and sewage versus collective treatment of the three wastes were evaluated. The collected data revealed that an oil trap is necessary prior to using one of the techniques considered for treatment of the final effluent, these being coagulation-sedimentation, biological-batch treatment, and continuous treatment. High quality effluent could be obtained using the two proposed schemes. In addition, the initial as well as the current costs for both alternatives were almost the same. However, biological treatment is recommended since it solves the problem of the wastes in the plant using one treatment system that can be easily controlled. (Friedmann-PTT)
W90-00769

BIOLOGICAL REMOVAL OF SULPHATE FROM INDUSTRIAL EFFLUENTS AND CONCOMITANT PRODUCTION OF SULPHUR.
National Inst. for Water Research, Pretoria (South Africa).
J. P. Maree, and E. Hill.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 265-276, July 18 1989. 8 fig, 5 tab, 15 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Sulfates, *Industrial wastes, *Sulfur, Complete wastewater treatment, Stage treatment, Effluents, Chemical degradation.

Sulfate wastes, such as sulfate-rich industrial effluents or waste gypsum, present a serious environmental pollution problem. A biological sulfate removal process has been evaluated for the treatment of these wastes. In this process, sulfate is converted to H2S when a carbon source such as molasses, is added. A complete mix reactor was used for sulfate reduction to H2S, which was subsequently stripped off in a closed system with either CO2 or nitrogen as carrier gas. The H2S, in turn, is oxidized to elemental sulfur in the sulfur production stage when it is brought into contact with a ferric solution. In a subsequent aerobic stage, degradation of organic carbon residuals and calcium carbonate crystallization are achieved simultaneously. Strontium, which is present in waste gypsum, is removed partially in the anaerobic stage, and completely in the aerobic stage. It is shown that sulfate wastes can be treated by the biological sulfate process for the production of reusable water and/or the recovery of valuable by-products such as elemental sulfur, sodium bisulfide, and heavy metals. (Author's abstract)
W90-00770

AEROBIC PIGGERY SLURRY TREATMENT SYSTEM WITH INTEGRATED HEAT RECOVERY AND HIGH-RATE ALGAL PONDS.
West of Scotland Agricultural Coll., Auchincruive. Dept. of Microbiology.
I. F. Svoboda, and H. J. Fallowfield.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 277-287, July 18 1989. 2 fig, 8 tab, 19 ref.

Descriptors: *Wastewater treatment, *Farm wastes, *Animal wastes, *Slurries, *Aerobic treatment, *Heat treatment, Biological treatment, Model studies, Algal growth, Wastewater disposal.

Problems of disposal of agricultural effluents most frequently concern pig slurries because herd size need not be related to the area of land available for disposal. The search for alternative disposal strategies has been stimulated by the cost of disposal, concern over environmental effects and possible soil and plant nutrition problems associated with heavy or inappropriately timed slurry spreading. A piggery with an integrated slurry removal and treatment system with heat recovery and two algal raceways for a secondary treatment of settled treated slurry was developed. Piggery slurry from about 250 fattening pigs and 100 weaners were aerobically treated in a continuous culture reactor at 36 C. Metabolic heat and heat from the aerator after upgrading by a heat pump was utilized for space heating in a weaner house and in one of the algal raceways. Intermittent heating had little effect on algal productivity and effluent treatment since the system was essentially light-limited. Characteristics of treated slurry and quantity of heat evolved were in good agreement with predicted values of a mathematical model. (Author's abstract)
W90-00771

WET AIR OXIDATION OF TOXIC INDUSTRIAL EFFLUENTS.
Budapesti Mueszaki Egyetem (Hungary). Dept. of Chemical Technology.
J. Kalman, Z. Izsaki, L. Kovacs, A. Grofcsik, and I. Szebenyi.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 289-295, July 18 1989. 5 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Wet oxidation process, *Industrial wastes, *Culturing techniques, *Chemical treatment, Organic wastes, Cyanide, Effluents, Ammonium, Wastewater.

Wet air oxidation of process wastewater with a COD content of more than 60 g/l and very high cyanide concentration (up to 60-80 g/l) was studied in a laboratory batch reactor. At a temperature of 240 C and a reaction time of 30 minutes, more than 75% of the initial organic content of the wastewater was oxidized while at the same time the cyanide content of the wastewater was hydrolyzed to ammonium formate. The conversion of cyanide by hydrolysis was greater than 99.9997%, giving a remaining cyanide concentration of less than 0.01 mg/l. The reaction rate of hydrolysis of cyanide was found to be first order with respect to cyanide concentration. The reaction rate of cyanide hydrolysis was determined at five different temperatures. From the temperature dependence of the reaction rate, the activation energy and the pre-exponential factor of hydrolysis were found to be 52,080 J/mol and 0.0000243/min, respectively, according to the Arrhenius equation. A process for an industrial scale wet air oxidation unit for the treatment of effluent containing cyanide is proposed. In the process, the cyanide wastewater is pumped by a high pressure reciprocating pump to a heat exchanger. Air is pumped to the heat exchanger by a compressor at an air flow rate of 85 cu Nm/h. The cold wastewater is heated up by the hot, treated effluent in the tube-type heat exchanger. The influent wastewater is heat up to 200-220 C and the effluent (cyanide-free) is cooled to 40-60 C. (Author's abstract)
W90-00772

ACTIVATED SLUDGE TREATMENT OF COAL-GASIFICATION EFFLUENT IN A PETROCHEMICAL PLANT: II. METAL ACCUMULATION BY HETEROTROPHIC BACTERIA.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Microbiology.
H. C. Kasan, and A. A. W. Baecker.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 297-303, July 18 1989. 5 fig, 3 tab, 33 ref.

Descriptors: *Industrial wastes, *Heterotrophic bacteria, *Wastewater treatment, *Activated sludge process, *Coal gasification, *Bioaccumulation, Activated sludge, Oil industry, Bioindicators, Heavy metals, Effluents.

The use of microbial cells as biosorbents of heavy metals is a potential alternative to conventional methods used to decontaminate liquid wastes. Metal-tolerant bacteria were surveyed in an activated sludge process treating coal-gasification effluent in a zero-effluent water reclamation system at a petrochemical plant. Furthermore, the potential of these bacteria as metal biosorptive agents was investigated. Atomic absorption analyses of liquid and solids fractions of sludge showed that Fe, Cr, Zn, Ag, Hg, Cu, C, Pb, Ni, and Co were present in that order of decreasing concentration, and that in all cases, solids fractions contained highest metal concentrations. Seventeen metal-tolerant bacteria were isolated from the sludge and were shown to remove metals from broths in which they grew. In further broths also containing 100 mg/l of metal ions, Pseudomonas cepacia, Flavobacterium sp., Ps. sp, and Enterobacter aerogenes effected biosorption of iron; Ps. maltophila and Ps. paucimobilis biosorbed copper; Ps. cepacia (strain 1) biosorbed chromium, and Ps. cepacia (strain 2) and Zoogloea sp. effected biosorption of nickel. (Friedmann-PTT)
W90-00773

MODELLING OF NITRIFICATION AT THE MOGDEN TREATMENT WORKS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
J. P. Lumbers, S. C. Cook, and G. A. Thomas.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 305-314, July 18 1989. 18 fig, 7 ref.

Descriptors: *Model studies, *Wastewater treatment, *Wastewater management, *Wastewater facilities, *Nitrification, *Cost analysis, Monte Carlo Method, Aeration, Activated sludge process, Sensitivity analysis.

Process models can act as an aid to the operator of a wastewater treatment plant to minimize the cost of treatment and maximize performance. THe general lack of on-line measurements of pollution load means that such models could be used off-line rather than on-line for the foreseeable future. This contrasts to the water supply distribution module in which real-time measurements are readily available. An activated sludge model is developed to investigate loss of nitrification at the Mogden Works, England. This dynamic kinetic model, which is applied to identify, calibrate and validate a model of the nitrification dynamics of the Mogden Works, provided an estimate of the population of eutrophic bacteria and other unmeasured state variables that give a better understanding of the influences of input conditions and operational policies. A Monte Carlo simulation and generalized sensitivity analysis were found to be effective ways of identifying appropriate parameter values and their importance. The principal control options explored were varying the aeration rate and the sludge surplussing rate. It was found that the loss of nitrification around day 12 of the model application was greatly reduced by increasing the aeration. This loss of nitrification appeared to have been associated with a predicted low concentration of autotrophic bacteria. The effect of a 20% reduction in the surplussing rate was modeled, which increased the predicted concentration of autotrophs over the period. A 7% increase in the aeration input was simulate together with the reduction in surplussing, which effected a sufficient improvement in nitrification to maintain desired levels. It is shown that the model can be usefully applied in the investigation of nitrification problems by identifying those periods when measured input conditions and operating policies are the causal factors and those where further investigations of other influences is required. (Friedmann-PTT)
W90-00774

BEHAVIOUR AND MODELLING OF NTA DEGRADATION IN ACTIVATED SLUDGE SYSTEMS.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Siegrist, A. Adler, W. Gujer, and W. Giger.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 315-324, July 18 1989. 7 fig, 2 tab, 14 ref.

Descriptors: *Detergents, *Model studies, *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, *Activated sludge process, Biodegradation, Adsorption, Secondary wastewater treatment, Degradation, Effluents, Sludge digestion, Nitrilotriacetic acid.

The general model for single-sludge wastewater treatment systems of the IAWPRC task group was extended to describe the biological degradation of nitrilotriacetate (NTA) and adsorption of NTA onto activated sludge based on literature studies and experiments undertaken at the Glatt wastewater treatment plant (wastewater discharge: A = 55-6,000 cu m/d, 110,000 inhabitants) for the city of Zurich. During two days, the behavior and diurnal load variation of NTA, zinc, lead and copper were analyzed on one lane (volume = 1, 812 cu m, Q = 14,700 cu m/d) of the four parallel lanes used in secondary treatment. The plant had a sludge age of about 3.6 days and was partly nitrifying (wastewater temperature = 10-11 C). The average daily load of NTA for the investigated lane was 14 kg NTA/d, corresponding to 0.5 g NTA/person-day. The influent concentration varied between 300 and 1,500 micrograms NTA/l. NTA was biologically degraded up to 97%. Between 12 a.m. and 2 p.mm of the second day, 17 kg NTA (120% of the daily load of one lane) had been added to the primary effluent. During 4 to 5 hours, the biological NTA degradation was saturated and four times more than the daily average of NTA was degraded. Zinc and lead did increase in the secondary effluent during the NTA shock loading. (Author's abstract)
W90-00775

PRECIPITATION OF FERRIC PHOSPHATE IN ACTIVATED SLUDGE: A CHEMICAL MODEL AND ITS VERIFICATION.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W90-00776

CONCEPT OF SOLUBLE RESIDUAL PRODUCT FORMATION IN THE MODELLING OF ACTIVATED SLUDGE.
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
D. Orhon, N. Artan, and Y. Cimsit.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 339-350, July 18 1989. 8 fig, 5 tab, 16 ref.

Descriptors: *Model studies, *Wastewater treatment, *Activated sludge, *Activated sludge process, *Microbial degradation, *Organic wastes, Mathematical studies, Mathematical equations, Biodegradation, Sludge digestion, Chemical oxygen demand.

The soluble effluent COD of a well-operate activated sludge plant is likely to be composed almost entirely of organic matter generated by microbial activity. There is evidence that a significant portion of this soluble organic matter is non-degradable and may be due to similar microbial mechanisms. A model for the formation of these soluble residual products (SRP), is proposed. The model relates the SRP formation to the hydrolysis of nonviable cellular materials in the reactor. A set of equations describing the mode are successfully calibrated and verified for a set of representative experimental data derived from sequencing batch reactors. The model is found to explain and predict COD accumulation at the end of each cycle of these activated sludge systems. Model verification showed that the presence of SRP, attested by soluble COd accumulation during the cyclic operation of a sequencing batch reactor system, is a significant factor to account for, in the modeling and system performance evaluation of the activated sludge process. The traditional Monod-type of rate expression appears to be a useful tool in identifying the appropriate phase and mechanism for SRP generation. (Author's abstract)
W90-00777

DYNAMIC MODELLING OF TRACE CONTAMINANT REMOVAL IN A MUNICIPAL SEWAGE TREATMENT PLANT.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, H. Monteith, M. Newbigging, S. G. Nutt, and J. P. Stephenson.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 351-362, July 18 1989. 4 fig, 3 tab, 8 ref.

Descriptors: *Model studies, *Wastewater treatment, *Municipal wastewater, *Trace elements, *Heavy metals, *Organic compounds, Effluents, Pollutants, Time series analysis, Temporal distribution.

The variability of influent and effluent concentrations of trace contaminants at a full-scale municipal sewage treatment plant (STP) was measured by intensive sampling at two hour intervals for eight consecutive days. From these data, the technique of time series analysis was used to generate predictive models describing the process response. The data indicated that municipal STPs are capable of efficient trace contaminant removal and significantly attenuate the variability of these contaminats in the raw influent. Significant correlations were identified between influent characteristics and effluent concentrations for selected contaminants. For three metals and three trace elements, adequate time series models were developed. These models were developed to describe the response of a full-scale STP to perturbations in the influent characteristics for the selected trace ele-

ments, copper, zinc, chromium, tetrachloroethylene, 1,1,1-trichloroethane, and 1,4-dichlorobenzene. The time between the beginning of the influent perturbation and the beginning of the effluent response (lag time) for these six contaminants varied between 4 and 8 h. THe time constant, which represents the time required for the effluent to achieve 63.2% of its final steady state value after initiation of the response to a step change in influent conditions, varied from about 5 to 17 h for these contaminants compared to the nominal plant HRT of 9 h. The steady state process gains, which indicate the magnitude of the effluent response to a unit change in the influent variable, were lower than the average removal efficiencies, indicating that removal efficiency improved at higher influent concentrations. The time series models allow prediction of the response of a complex process to an influent perturbation without total knowledge of the reactions and removal mechanisms occurring in the process. (Friedmann-PTT)
W90-00778

METABOLISM OF CARBOXYLIC ACIDS LOCATED IN AND AROUND THE GLYCOLYTIC PATHWAY AND THE TCA CYCLE IN THE BIOLOGICAL PHOSPHORUS REMOVAL PROCESS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
V. Arun, T. Mino, and T. Matsuo.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 363-374, July 18 1989. 7 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Biological wastewater treatment, *Anaerobic digestion, *Carbon cycle, Anaerobic conditions, Biological treatment, Carbon, Metabolism, Chemical properties.

Anaerobic batch experiments were performed to measure the profile of various parameters when phosphorus accumulating sludge acclimatized under anaerobic-aerobic operation is fed with malic, lactic, pyruvic, propionic and succinic acids, carboxylic acids that lie in the vicinity of the clycolytic pathway and the tricarboxylic acid cycle, two pathways central to the utilization of organics as sources of energy and carbon in most microorganisms. Carbon dioxide gas produced during substrate uptake was also measured. In most cases, intra-cellular carbohydrate reserves are consumed and the NADH2 that is consequently produced requires that there be some subsequent reaction that utilizes it. The microorganisms responsible for phosphorus removal in the A-A process should be capable of accumulating high energy polyphosphates and glycogen within the cell under aerobic conditions. The former would serve as the energy source for the uptake of organics under anaerobic conditions, while the latter would serve to regulate the redox balance by providing reducing power in the form of NADH2 by its utilization, which is required for the synthesis of reductive polymers from the organics taken up. The synthesized polymers are stored in intra-cellular locations for use in the subsequent aerobic phase, thereby gaining positive advantage over non-phosphorus accumulating species. (Author's abstract)
W90-00779

ROLE OF ACETATE IN DENITRIFICATION AND BIOLOGICAL PHOSPHATE REMOVAL IN MODIFIED BARDENPHO SYSTEMS.
National Inst. for Water Research, Pretoria (South Africa).
C. T. Winter.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 375-385, July 18 1989. 10 fig, 7 tab, 6 ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Denitrification, *Biological wastewater treatment, Phosphates, Absorption, Organic compounds, Substrates.

The importance of easily biodegradable organic substances such as acetate and propionate in biological phosphate removal has been recognized by many researchers. Laboratory-scale studies on the performance of three-stage modified Bardenpho nutrient removal systems, fed with settled sewage supplemented with 0, 50, 100 and 200 mg/l sodium acetate, respectively, are described. Particular attention is given to the effects of these additions on biological phosphate release and uptake and also to the fate of parameters such as pH, calcium, potassium, ammonia and nitrate. Additional phosphate of 10 mg/l (as P) was initially introduced into the feed in order to burden the experimental systems beyond their normal phosphate removal capacity. This was increased to 20 mg/l and eventually to 40 mg/l of phosphate (as P). Increasing concentrations of sodium acetate resulted in distinct increases in pH values, increase in phosphate release in the anaerobic zones and significantly improved overall phosphate removal in the experimental units. The correlation of phosphate removal on acetate concentration was found to be 0.9886. In some instances, the unit receiving 200 mg/l acetate removed up to an average of 30 mg/l of phosphate (as P), constituting an improvement of up to 200% compared with the unit receiving no acetate. The alternating release and uptake of phosphate was accompanied by an equivalent sequence for potassium and magnesium. The high pH value plus the disappearance of phosphate, ammonia and magnesium places doubt on a purely biological phosphate removal but could point at the crystallization of ammonium magnesium phosphate. (Author's abstract)
W90-00780

CARBON FLOW PATTERNS IN ENHANCED BIOLOGICAL PHOSPHORUS ACCUMULATING ACTIVATED SLUDGE CULTURES.
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
K. Bordacs, and S. C. Chiesa.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 387-396, July 18 1989. 10 fig, 12 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Activated sludge process, *Carbon, *Biological wastewater treatment, *Phosphorus removal, *Stage treatment, Anaerobic digestion, Aerobic digestion, Culturing techniques, Sludge digestion.

The limited knowledge of biochemical mechanisms involved in biological phosphorus (bio-P) removal has hindered the successful full-scale application of such processes. It is recognized that enhanced phosphorus accumulation in activated sludge appears to be governed by an essentially biological mechanism. However, the pathways by which phosphate uptake in excess of the metabolic requirements of the microbial population(s) is accomplished is still vague. Carbon flow was tracked in an anaerobic/aerobic staged system to compare results with proposed mechanisms. The tracking was done using radiolabelled glucose and acetate as substrates. Batch studies using the labelled substrates verified that acetate and glucose are metabolized differently and acetate would be a more effective source of organic material for carbon supplementation. The use of acetate ensures that the greatest percentage of added carbon will be sequestered by phosphorus accumulating species. Carbon flow was also evaluated in a bench-scale SBR system by wet chemistry methods to correlate the findings of the batch studies with that of the long-term carbon profiles. It was found that the use of the carbon labelled substrates allow the analysis of the carbon flow in phosphorus accumulating mixed cultures fed with complex feed mixtures. Carbon flow patterns in phosphorus accumulating mixed cultures, as observed with 14C labelled organic substrates, were consistent with recently developed biochemical models for bio-P removal processes. (Friedmann-PTT)
W90-00781

ISOLATION AND CHARACTERIZATION OF VOLUTIN GRANULES AS SUBCELLULAR COMPONENTS INVOLVED IN BIOLOGICAL PHOSPHORUS REMOVAL.
National Inst. for Water Research, Pretoria (South Africa).
J. B. Heymann, L. M. Eagle, H. A. Greben, and D. J. J. Potgieter.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 397-408, July 18 1989. 3 fig, 2 tab, 39 ref.

Descriptors: *Phosphorus removal, *Volutin, *Wastewater treatment, *Dyes, *Chemical treatment, *Phosphorus, *Biological treatment, Microorganisms, Bacteria.

Volutin occurs in numerous microorganisms as spherical granules ranging from 0.01 to 2 microns in diameter and displaying the special property of metrachromacity when stained with basic dyes such as methylene blue and toludine blue. The main compounds occurring in the granules from Acinetobacter calcoaceticus were found to be polyphosphate and poly-beta-hydroxybutyrate (PHB), together with nucleic acids, metal cations and some protein. Two types of granule have been found based on the predominant compound and have been denoted as P-volutin and L-volutin granules. P-volutin granules are phosphorus-rich while L-volutin granules consist largely of PHB. L-volutin was found to be formed in a medium supplying sufficient nutrients, while P-volutin formed after induction of the phosphorus-accumulating apparatus by phosphorus-starvation. In biological phosphorus removal, PHB is synthesized under anaerobic conditions and degraded during aeration, while phosphorus accumulation follows a complimentary pattern. The exact significance of the formation of the two types of granules is not clear, although their formation under different conditions in Acinetobacter suggests a similar mechanism to that operational in activated sludge. (Author's abstract)
W90-00782

SLIP-LINING AVOIDS REPLACEMENT OF BREAK-PLAGUED SEWER FORCE MAIN.
June Lake Public Utility District, CA.
L. D. Ainsworth, S. Phelps, and D. Cantrell.
Public Works PUWOAH, Vol. 120, No. 9, p 73-74, August 1989.

Descriptors: *California, *Pipelines, *Conveyance structures, *Sewer systems, *Slip linings, Recreational areas, Force main breaks, Spills, Costs.

The June Lake sewer system consists of a three-mile gravity interceptor fed by 30 small lift stations, delivering wastewater to the main lift station. From there, wastewater is pumped to the treatment plant nine miles away, far from the important recreational areas. However, due to a poorly-specified PVC force main, improperly installed in the early 1970s, the Rush Creek/Silver Lake waterway has suffered spills due to force main breaks in the last several years. It was decided to install a 14-in ductile iron pipe above the PVC mains for the first 1400 ft out of the lift station where most of the breaks had occurred. Because excavating for the planned new pipe along the section of state highway immediately above and adjacent to the shore of the lake presented several intractable problems, it was decided to use the slip-lining technique. Since, the pipe alignment was fairly straight and flat, up to 2,000-ft lengths of polyethylene pipe were pulled through. The specified pressure was just above pump station shut-off head; the line passed and was placed into service about one month after actual liner-pulling was started. Cost of the project was $34 per foot, but the other benefits were just as important, as there was virtually no disruption of recreational traffic nor chance of sewage spills during construction. (White-Reimer-PTT)
W90-00794

BATON ROUGE TACKLES SEWERAGE IMPROVEMENTS FOR COMPLIANCE.
Camp, Dresser and McKee, Inc., Baton Rouge, LA.
R. Cloutier, and J. G. Richard.
Public Works PUWOAH, Vol. 120, No. 9, p 80-82, August 1989.

Descriptors: *Louisiana, *Baton Rouge, *Wastewater facilities, *Water pollution control, Construction, Costs, Economic aspects, Secondary wastewater treatment.

Baton Rouge and its encircling parish (county) are engaged in a program to ease the strain of an overburdened wastewater treatment system that has caused numerous health and pollution problems. In 1984 the EPA ordered the city/parish to comply with administrative orders requiring completion of improvements by January 1, 1988. Two funding mechanisms were established. About half the construction program cost and all the operations and maintenance costs are paid by sewer user fees. The other half of the construction expense is funded from a 1/2-cent sales tax approved in late 1988. The program consists largely of abandoning the numerous small suburban treatment facilities and expanding the three existing major plants. Based on projected increased sewage flow and population growth, the North plant will be expanded to treat a roughly doubled average daily flow of 22.8 mgd. Preliminary treatment facilities will handle odor control and grit removal and include two primary settling tanks, two trickling filters, two final settling tanks, and an additional sludge handling unit. The South plant will be expanded to almost double its average daily flow to 34.7 mgd and will include upgrades similar to the North plant. The Central plant will increase its average peak hourly flow from 22.0 mgd to 64.3 mgd, supplementing its pure oxygen activated secondary sludge process with a trickling filter system. As a result of sound planning and management, the total program is currently on schedule and within budget. (White-Reimer-PTT)
W90-00797

EFFECT OF A SEWAGE PLANT IN THE DISTRIBUTION OF ORGANOCHLORINE RESIDUES IN THE DIYALA RIVER, IRAQ.
Biological Research Center, Baghdad (Iraq).
For primary bibliographic entry see Field 5B.
W90-00799

DETECTION OF ENDOTOXINS IN RECLAIMED AND CONVENTIONALLY TREATED DRINKING WATER.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 5A.
W90-00830

BEHAVIOUR OF PHTHALIC ACID ESTERS DURING BATCH ANAEROBIC DIGESTION OF SLUDGE.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
K. Ziogou, P. W. W. Kirk, and J. N. Lester.
Water Research WATRAG, Vol. 23, No. 6, p 743-748, June 1989. 1 fig, 2 tab, 32 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Sludge digestion, *Phthalates, Priority pollutants, Biodegradation, Anaerobic digestion.

In experiments with batch anaerobic digestion of sewage sludge spiked with the six phthalic acid esters classified as priority pollutants, that is dimethyl, diethyl, di-n-butyl, butyl-benzyl, di-(2-ethyl-hexyl) and di-n-octyl, at a concentration range of 0.5-10 mg/L, the first four esters were found to degrade rapidly with degradation rates following first order reaction kinetics, whereas di-(2-ethylhexyl) and di-n-octyl phthalates appeared to be persistent under the same experimental conditions. (Author's abstract)
W90-00832

NEW METHOD OF DESIGN OF STEAM-DISTILLATION TREATMENT OF WASTEWATER.
East China Inst. of Chemical Technology, Shanghai. Dept. of Environmental Engineering.
Y. Wang, and B.-W. Xu.
Water Research WATRAG, Vol 23, No. 6, p 785-790, June 1989. 6 fig, 12 tab, 7 ref.

Descriptors: *Wastewater treatment, *Distillation, *Chemical wastewater, Volatile organic compounds, Steam, Mass transfer, Design criteria.

For the treatment of wastewater containing acrylonitrile from acrylic fibre manufacture, and benzene and its derivatives from polystyrene, the more volatile components are stripped off by steam for recovery while the effluent can be innocuously discharged after steam-distillation. The factors which affect the process of treating wastewater are discussed in detail based on a mass transfer theory. The steam/wastewater (or condensate/wastewater) ratio in the design and operation may be conveniently controlled by a final graph which is provided by this study from material balance. (Author's abstract)
W90-00837

CHARACTERIZATION AND TREATMENT OF DAIRY EFFLUENTS BY FREE AND IMMOBILIZED YEAST.
Punjabi Univ., Patiala (India). Dept. of Biotechnology.
S. S. Marwaha, J. F. Kennedy, H. K. Tewari, and A. Redhu.
Process Biochemistry PRBCAP, Vol. 24, No. 2, p 46-51, April 1989. 4 fig, 3 tab, 21 ref.

Descriptors: *Wastewater treatment, *Yeasts, *Biological wastewater treatment, *Food-processing wastes, *Dairy industry, Industrial wastes, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Bacteria, Fungus, Coliforms.

The data on physical, chemical and microbiological characterization of periodically collected effluent samples from the composite milk plant, and their subsequent treatment using free and alginate-entrapped Candida pseudotropicalis cells in a batchwise process at laboratory scale are presented. For all the samples, pH (5.4-9.2) and temperature (16.3-33.8 C) were generally within the permissible limits of the Indian Standards Institution (ISI) for the discharge of industrial effluents. The contents of biochemical oxygen demand (BOD5: 186-914 milligrams/liter), chemical oxygen demand (COD: 306-1600 milligrams/liter), total suspended solids (TSS: 355-3816 milligrams/liter) of all the samples and total dissolved solids (TDS: 561-4103 milligrams/liter) of two samples were much higher than the permissible legal limits. The bacterial, fungal and yeast counts of the samples ranged from 5 to 13,000,000/milliliter, 0 to 200,000/milliliter, and 3 to 48,000/milliliter, respectively. All the samples were found coliform positive. The comparison of free and immobilized yeast cell technologies for the treatment of dairy effluents indicated the latter process to be slightly better than the former. Both systems, however, have been found to dilute the pollutants (BOD5 and COD) to ISI safe levels. (Author's abstract)
W90-00871

ANAEROBIC TREATMENT OF OLIVE MILL EFFLUENTS IN POLYURETHANE FOAM BED REACTORS.
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
A. Rozzi, R. Passino, and M. Limoni.
Process Biochemistry PRBCAP, Vol. 24, No. 2, p 68-74, April 1989. 5 fig, 3 tab, 18 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Food-processing wastes, *Biological wastewater treatment, Sludge digestion, Industrial wastes, Foams, Filters, Performance evaluation, Organic carbon.

Anaerobic treatment of olive mill effluents, diluted with tap water, was tested on laboratory fixed film reactors filled with macroreticulated polyurethane foam. The effect of substrate concentration, geometry of foam elements and of alkali addition on removal efficiency were investigated. Total organic carbon (TOC) removal efficiency increased from 55-60% to 70-75% keeping the same substrate concentration. Increased feed concentration further improved TOC removal efficiencies. Foam geometry had a negligible effect on reactor performance. The start-up time of anaerobic filters filled with foam was appreciably shorter than that for suspended growth reactors. Dosing of alkali chemicals needed for stable operating conditions decreased as feed concentration increased. (Geiger-PTT)
W90-00872

COMPARISON OF CHEMICAL FLOCCULATION AND DISSOLVED AIR FLOTATION OF ANAEROBICALLY TREATED PALM OIL MILL EFFLUENT.
Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Chemistry.
C. C. Ho, and Y. K. Tan.
Water Research WATRAG, Vol. 23, No. 4, p 395-400, April 1989. 7 fig, 2 tab, 15 ref.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Food-processing wastes, *Flocculation, *Air flotation, Flotation, Biological oxygen demand, Suspended solids, Effluents, Aluminum sulfate, Polyelectrolytes.

The effectiveness of chemical flocculation and dissolved air flotation process as applied to the secondary treatment of the anaerobically digested liquor of palm oil mill effluent (POME) was investigated and compared. Results indicated that the dissolved air flotation method was more efficient than chemical flocculation in an all round removal of pollutants from the digested liquor. Even though both methods were able to achieve a 97% removal of the suspended solids of the digested liquor, the removal of soluble matter of inorganic and organic origins was far from satisfactory. This is in general agreement with the recognized view of the superior efficiency of biological methods over physico-chemical methods in treating soluble substances. A 94% suspended solids removal efficiency and an 80% BOD removal efficiency was achieved by the dissolved air flotation unit. When aluminum sulfate and polyelectrolyte C as flocculant were added to the flotation system, the removal efficiency of BOD was increased to 90% but the suspended solids removal was only increased marginally to 97&. The inorganic coagulant together with the polymeric flocculant would destabilize the particulates. The flocs thus developed could adhere to the micro-bubbles resulting in a better rate of flotation of the suspended flocs. (Peters-PTT)
W90-00898

OXIDATION OF PHENOLIC POLLUTANTS BY A LIGNIN DEGRADING ENZYME FROM THE WHITE-ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM.
Notre Dame Univ., IN. Dept. of Civil Engineering.
M. D. Aitken, R. Venkatadri, and R. L. Irvine.
Water Research WATRAG, Vol. 23, No. 4, p 443-450, April 1989. 1 fig, 7 tab, 51 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Fungi, *Biodegradation, *Phenols, Enzymes, Industrial wastes.

The wood rotting fungus Phanerochaete chrysosporium produces lignin degrading enzymes that have been implicated in pollutant degradation by the organism. One of these enzymes, ligninase, was studied to evaluate its application potential in industrial wastewater treatment. The enzyme was observed to catalyze the oxidation of several phenolic pollutants by hydrogen peroxide, although only partial removal of target compounds was observed in preliminary tests. A number of subsequent tests were conducted to improve target compound removal, using o-cresol as model substrate. Removal of o-cresol was enhanced by increasing enzyme concentration, by adding the co-catalyst veratryl alcohol (3,4-dimethoxybenzl alcohol), or by controlling the rate of addition of hydrogen peroxide to batch reaction systems. Controlled addition of peroxide is proposed to minimize enzyme inactivation during reaction, thereby extending the useful life of the enzyme. (Author's abstract)
W90-00904

UNCERTAINTY MODELING OF FACULTATIVE AERATED LAGOON SYSTEMS.
Serrener Consultation, Inc., Montreal (Quebec).
S. Ouldali, R. Leduc, and V.-T.-V. Nguyen.
Water Research WATRAG, Vol. 23, No. 4, p 451-

459, April 1989. 3 fig, 4 tab, 33 ref. NSERC Canada Grant No. A4819.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Model studies, *Wastewater lagoons, Mathematical models, Biodegradation, Municipal wastewater, Industrial wastewater, Biological oxygen demand, Kinetics, Aerated lagoons, Differential equations.

A stochastic differential equation (SDE) model is proposed to predict output BOD variations of lagoon systems. Assuming that complete mixing and first-order kinetics of biodegradation occur, a mass balance for BOD is written for each lagoon. A random disturbance term that accounts for input noise, is added to the deterministic differential equation that describes the process. The lower (first and second) moments are derived to obtain expectation and variance of the effluent BOD concentration. Assuming steady-state, model calibration and verification were performed on the lagoon systems of the municipalities of Sainte-Julie and Lac-Etchemin (Quebec). The model gives a reliable prediction of the lagoons output fluctuations, and represents a new tool for uncertainty modeling of facultative aerated lagoons. (Author's abstract)
W90-00905

ORGANIC POLLUTANTS IN URBAN SEWAGE AND POLLUTANT INPUTS TO THE MARINE ENVIRONMENT. APPLICATION TO THE FRENCH SHORELINE (LES POLLUTANTS ORGANIQUES DANS LES EFFLUENTS URBAINS ET APPORTS POLLUTANTS DANS LE MILIEU MARIN. CAS DU LITTORAL FRANCAIS).
Institut Francais de Recherche pour l'Exploitation de la Mer, Brest. Dept. Environnement Littoral.
For primary bibliographic entry see Field 5B.
W90-00906

OZONE CONSUMPTION KINETICS IN FILTERED ACTIVATED SLUDGE EFFLUENTS: A MODIFIED APPROACH.
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
R. D. Watt, E. J. Kirsch, and C. P. L. Grady.
Water Research WATRAG, Vol. 23, No. 4, p 471-480, April 1989. 8 fig, 3 tab, 31 ref. NSF Grant No. CME-77-12649.

Descriptors: *Ozonation, *Activated sludge, *Sludge conditioning, Kinetics.

Effluent samples were collected from eight laboratory activated sludge reactors. Practical ozone doses (2-12 mg/L) were applied to these samples in batch tests in order to measure ozone consumption rates. The rate method was varied by using different initial ozone concentrations, dilution factors and levels of preozonation. Resulting rate data showed that pseudo-n-order kinetics were inappropriate because consumption rates depended on how much ozone had already been consumed, as well as on instantaneous ozone concentration. Instead, data fit a modified rate expression which was first-order with respect to ozone and in which the pseudo-first order rate constant was replaced by a variable, the specific ozone utilization rate w. Like a pseudo-first-order rate constant, w hypothetically can be related to concentrations of reacting compounds and their reaction rate constants, but w is allowed to vary as reacting species change during ozonation. The behavior of w depended on sample character, the consumed ozone dose and the dilution factor used in a rate test. In all cases, values of w decreased as ozone was consumed, indicating that reactive solutes were being oxidized to less reactive compounds. (Author's abstract)
W90-00907

METHODOLOGY FOR THE ASSESSMENT OF FREQUENCY DISTRIBUTION OF COMBINED SEWER OVERFLOW VOLUMES.
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. P. Benoist, and L. Lijklema.
Water Research WATRAG, Vol. 23, No. 4, p 487-493, April 1989. 4 fig, 4 tab, 14 ref.

Descriptors: *Combined sewer overflows, *Model studies, *Storm water, *Storm sewers, *Stochastic process, Correlation analysis, Mathematical models, Design criteria, Rainfall intensity.

A stochastic approach for the calculation of the frequency distribution of overflow volumes is presented. The methodology has been tested with a data set comprising rainfall, overflow volumes and pollutant loads. The stochastic approach involves a multiplication of two stochastic variables, rainfall intensity and duration. Correlation between these variables leads to erroneous results. An improvement can be obtained by subclassification of the data set, in order to remove the effect of this interdependency. However, the correlation between input variables cannot be removed entirely by the method of subclassification. (Author's abstract)
W90-00909

PILOT SCALE AEROBIC SEQUENCING BATCH REACTOR FOR PIG WASTE TREATMENT.
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
S. H. Wong, and C. C. Choi.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 75-81, February 1989. 4 fig, 7 tab, 17 ref.

Descriptors: *Farm wastes, *Waste treatment, *Wastewater treatment, *Aerated lagoons, *Activated sludge, Aerobic sequencing batch reactor, Biological oxygen demand, Operating costs.

An existing aerated lagoon treating piggery waste was converted into an aerobic sequencing batch reactor (SBR). After the commissioning period, the SBR plant treated piggery wastewater containing BOD and suspended solids (SS) concentrations of 2881 mg/L and 1419 mg/L respectively, producing an effluent having an average BOD and SS of 18.7 mg/L and 12.3 mg/L respectively. The volumetric loadings on the SBR and the process were similar. However, the SBR process operated at a lower mixed liquor suspended solids (MLSS) concentration and shorter sludge retention period. Although the capital and operating costs of the SBR are higher than for the aerated lagoon, the simplicity of operation, the high BOD and SS removal efficiency, and the small land requirement make this type of process an attractive treatment option, particularly in places where land supply is limited and expensive. (Author's abstract)
W90-00928

SEWAGE TREATMENT BY REED BED SYSTEMS.
Water Research Centre, Stevenage (England).
P. F. Cooper, J. A. Hobson, and S. Jones.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 60-74, February 1989. 8 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Land disposal, *Reeds, *Root zone, *United Kingdom, Reed bed treatment system.

In the past five years sewage-treatment systems, based on artificial reed beds, have created much interest in Europe. In the UK, reed bed treatment systems have attracted this interest because of their potential for producing cost-effective treatment for small communities. In 1985 a UK coordinating group was established to produce an integrated research and development programme for evaluating the process. The reed bed treatment system is a method of sewage treatment in an artificially-constructed wetland containing common reeds (Phragmites australis). Sewage flows through a bed of either soil or gravel in which reeds are growing. The results of performance from eight full-scale and pilot-scale systems indicate that even a year of constant flow operation is not long enough to for the beds to reach a steady state. With the full-scale beds, there appears to be a slight deterioration in effluent quality during the winter. The systems built in gravel performed well from the start, However, most of the treatment at this stage is likely to be due to physical filtration. Some of the systems built in soil have suffered from overland flow and excessive weed growth. The roles played by treatment by the soil and the above-ground layer of decaying debris still have to be evaluated for soil systems. Although it is too early to make conclusions, data from most of the systems which have been fully sampled and analyzed are encouraging, especially when it is considered that they are far from the mature state. (Rubinstein-PTT)
W90-00929

5E. Ultimate Disposal Of Wastes

HYDROGEOCHEMISTRY OF URANIUM AND ASSOCIATED ELEMENTS AT ABANDONED URANIUM MINES IN WESTERN NORTH DAKOTA.
Geological Survey, Bismarck, ND.
For primary bibliographic entry see Field 5B.
W90-00046

PROGRAM OVERVIEW AND SELECTED PAPERS FROM THE TOXIC-WASTE PROGRAM TECHNICAL MEETING: TUCSON, ARIZONA, MARCH 20-22, 1984.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W90-00052

ROLE OF GEOCHEMICAL PROCESSES IN HAZARDOUS-WASTE STUDIES.
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W90-00053

ROLE OF EARTH-SCIENCE CRITERIA IN THE SELECTION OF HAZARDOUS-WASTE DISPOSAL SITES.
Geological Survey, Columbus, OH. Water Resources Div.
A. M. LaSala.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 37-63, 7 fig, 5 tab, 30 ref.

Descriptors: *Site selection, *Waste disposal, *Hazardous wastes, *Water pollution prevention, *Geohydrology, Biodegradation, Land disposal, Groundwater movement, Landfills, Path of pollutants, Geochemistry, Economic aspects, Social aspects.

Earth science criteria should be part of a rational, objective method for selecting sites for disposal of hazardous chemical wastes on the land surface or in the subsurface. The functional requirements of the disposal system that must be met by the geologic, hydrologic, and geochemical characteristics of the site and its surroundings in degrading and isolating the wastes should be the basis for developing the criteria. Ideally, the earth science criteria should be used in combination with criteria related to engineering, economics, and social and environmental effects of the disposal system to select sites suitable for a disposal facility. The locating of sites for nuclear waste disposal has been approached (as described above) and can provide an example for disposal of other types of hazardous wastes. Aqueous wastes that are easily degradable by oxidation and biological activity can be applied to the land surface and treated by essentially natural processes. Physical and geochemical properties of soils and near-surface geologic materials are important criteria in siting facilities for these types of degradable wastes. Nondegradable, extremely hazardous chemical wastes require permanent isolation from the biosphere if burial or injection through wells is chosen for their disposal. Criteria for locating suitable sites should be related to attributes that favor long-term stability of the site, long paths and low velocities of groundwater flow, downward directions of groundwater flow, chemical retardation of waste movement, and deep burial. Current burial techniques employ secure landfills and rely mainly on packaging of wastes, manmade barriers to waste movement, and effluent controls to provide isola-

tion of the wastes from the biosphere. In many States, the requirements for site selection are related to site location (setback standards or areal exclusion criteria). (See also W90-00052) (Lantz-PTT)
W90-00055

MANUAL FOR SEWAGE SLUDGE APPLICATION TO CROPLANDS AND ORCHARDS.
Battelle Environmental Program Office, Washington, DC.
M. F. Arthur, B. W. Cornaby, A. R. Gavaskar, G. K. O'Brien, and M. G. Shafer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-110662. Price codes: A14 in paper copy, A01 in microfiche. Final Report, September 1988. 321p, 3 fig, 10 tab, 157 ref, 4 append. EPA Contract 68-01-6986.

Descriptors: *Handbooks, *Land disposal, *Wastewater farming, *Sludge disposal, *Waste disposal, Septic sludge, Agriculture, Model studies, Farm management.

A users handbook of sewage sludge application rates to agricultural lands. Based on a model, tables are presented for ten or more major crops (apples, barley, citrus, corn, cotton, forages, grapes, horticulture, oats) in 42 states or portions of states. Tabular application rate data are presented for sludge application rates in 42 areas. These rates consider the crops grown, their expected yield, the nature of the sludge aerobic or anaerobic, type of application (surface or soil incorporate), nature of the soil, and land slope. A model is also presented and, if data are available, site specific application rates can be estimated. Considered in the application rates site specific application rates can be estimated. Considered in the application rates are prevention of damage to crops, protection of neighboring waters from pollution by erosion of applied sludge, and rates of use of nutrients by the crops grown. Resulting sludge application rates are considered conservative to reduce risks to the land and crops, and nonpoint pollution of waters. (Author's abstract)
W90-00086

SITE CHARACTERIZATION: TECHNICAL APPROACHES TO RCRA COMPLIANCE.
Battelle Pacific Northwest Labs., Richland, WA. Site Characterization and Assessment Section.
For primary bibliographic entry see Field 5G.
W90-00091

GEOCHEMICAL INTERACTIONS OF HAZARDOUS WASTES WITH GEOLOGICAL FORMATIONS IN DEEP-WELL SYSTEMS.
Illinois State Geological Survey Div., Champaign.
W. R. Roy, S. C. Mravik, I. G. Krapac, D. R. Dickerson, and R. A. Griffin.
Environmental Geology Notes 130, 1989. 52p, 21 fig, 11 tab, 48 ref, 4 append.

Descriptors: *Deep wells, *Injection wells, *Underground waste disposal, *Path of pollutants, *Geochemistry, *Fate of pollutants, *Groundwater pollution, *Hazardous wastes, Inorganic acids, Brines, Neutralization, Dolomite, Siltstone, Carbonates, Hydrogen ion concentration, Sandstone, Chemical reactions, Geologic formations, Illinois.

Geochemical interactions of two liquid hazardous wastes with geologic materials from deep-well injection zones in Illinois were investigated by conducting laboratory studies. The liquid wastes included a dilute inorganic acid and a concentrated alkaline brine-like solution. The wastes were mixed with disaggregated core samples of two injection formations, the Mt. Simon Sandstone and Potosi Dolomite. Interactions were also studied with the Proviso Siltstone, which is considered part of a confining layer at two deep-well facilities in Illinois. The acidic waste neutralized when reacted with the dolomite and siltstone via carbonate dissolution with the concomitant generation of dissolved carbonate species and carbon dioxide. The acidic waste was partially neutralized by the sandstone via the dissolution of clay minerals and ion exchange, augmented by the dissolution of a small amount of dolomitic material With pH used as the hazardous criterion, the alkaline waste remained hazardous after reacting with the formation samples at 298 K-01.MPa and 313 K-6.0 MPa. At 328 K-11.7MPa, the waste formation mixtures were not hazardous by definition, but remained highly alkaline. The silica solid phases of the Mt. Simon Sandstone and Proviso Siltstone dissolved in the alkaline waste. The Potosi Dolomite was the least reactive of the three formations. In some cases, solution equilibria could be modeled using the thermodynamic principles of dissolution-precipitation of mineral phases. In other cases, empirical laboratory-based investigations are needed to assess the chemical interactions between injected wastes, injection formations, and associated formation waters. (Lantz-PTT)
W90-00141

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W90-00153

HAZARDOUS MATERIALS: MICROBIOLOGICAL DECOMPOSITION, JANUARY, 1978-AUGUST, 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-867593, Price codes: N01 in paper copy, N01 in microfiche. August 1988. 175p. Supercedes PB87-865895.

Descriptors: *Hazardous materials, *Waste disposal, *Fate of pollutants, *Bibliographies, Oil spills, Microbial degradation, Hydrocarbons, Pesticides, Bacteria, Fungi, Microorganisms.

This bibliography contains 360 citations concerning the decomposition of toxic materials by microorganisms; 16 of these citations are new entries to the previous edition. Organisms that digest hydrocarbons, petroleum, cyanide, and dioxin are discussed. Population studies of fungi and bacteria that decompose hazardous materials are included. Rates of decomposition, the presence of these microorganisms in the soil and in water, products generated from hazardous materials decomposition, and the use of these products by other microorganisms are among the topics discussed. (Author's abstract)
W90-00178

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA.
For primary bibliographic entry see Field 2F.
W90-00218

SUPERFUND RECORD OF DECISION (EPA REGION 2) LOVE CANAL, NIAGARA FALLS, NEW YORK, OCTOBER 1987. SECOND REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-00235

HAZARDOUS WASTE AND WASTEWATER CHARACTERIZATION SURVEY, COLUMBUS AFB MS.
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX. Human Systems Div.
For primary bibliographic entry see Field 5D.
W90-00240

APPLICATION OF A HAZARDOUS WASTE MANAGEMENT MODEL FOR SELECTED INDUSTRIES.
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W90-00241

EVALUATION OF PROPOSED DREDGED MATERIAL DISPOSAL ALTERNATIVES FOR NEW YORK/NEW JERSEY HARBOR, PHASE I.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. E. Poindexter, D. Gunnison, D. F. MacIntyre, and G. F. Goforth.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 773. Price codes: A06 in paper copy, A01 in microfiche. Technical Report EL-88-11, August 1988. Final Report. 168p, 36 fig, 29 tab, 91 ref, 4 append.

Descriptors: *Harbors, *Spoil disposal, *Waste disposal, *Dredging, *New York, *New Jersey, Sediment contamination, Model studies, Wastewater disposal, Computer programs, Water quality, Water quality standards.

This report documents the field collection of contaminated sediments from the New York/New Jersey Harbor, laboratory testing of those sediments, and initial evaluation of the test results. The work reported in this document is the first phase of a comprehensive evaluation of disposal alternatives for contaminated dredged material from the New York/New Jersey Harbor. The samples were combined and homogenized to form a worst-case contaminated sediment sample. This sample was then subjected to laboratory testing, including: analysis for microbial pathogens, sedimentation testing, consolidation testing, and modified elutriate testing. Testing procedures are described, and test results are presented. Results of the consolidation testing are used to develop containment area filling simulations for each of the confined disposal facilities under consideration. A computerized mathematical model is used to predict the settlement of the dredged material over time. The computer program uses an explicit finite difference technique to solve a finite strain consolidation equation; it makes monthly adjustments to account for any desiccation that has occurred at the dredged material surface. The microbial pathogens, sedimentation, and modified elutriate test results are used to make preliminary evaluations of effluent water quality from each of the confined disposal facilities (CDF). For more conclusive evaluations to be made, the existing water quality standards at each CDF must be known. (Lantz-PTT)
W90-00251

SEEDLING GROWTH RESPONSE IN A GREENHOUSE TO FOUR RATES OF OLD AND NEW PAPER MILL SLUDGE.
Arkansas Univ. at Monticello. Dept. of Forest Resources.
J. L. Yeiser.
Proceedings of the Arkansas Academy of Science AKASAO, Vol. 42, p 99-101, 1988. 6 tab, 5 ref.

Descriptors: *Greenhouses, *Sludge disposal, *Land disposal, *Pulp wastes, *Plant growth, *Pulp and paper industry, *Sludge, *Seedlings, *Pine trees, Agronomy, Dewatering, Industrial wastes.

Four rates (0,36,75,112 dry tons per acre) of both old and new pulp-mill sludges were tested in a greenhouse for impact on survival and growth of seedlings of loblolly pine(Pinus taeda L.). After one growing season no meaningful differences were detected for seedling survival and growth, number of flushes, and decomposition rate for old and new sludges regardless of rate. Seedling foliage showed increases in Mg and Ca and sludges exhibited high pH and increased salinity. (Author's Abstract)
W90-00283

NITROGEN TRANSFORMATIONS IN SOILS PREVIOUSLY AMENDED WITH SEWAGE SLUDGE.
Harvard Univ., Cambridge, MA. Lab. of Microbial Ecology.

For primary bibliographic entry see Field 5B.
W90-00382

OCCURRENCE OF CHLOROBENZENES AND PERMETHRINS IN TWELVE U.K. SEWAGE SLUDGES.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5D.
W90-00426

UPTAKE OF NICKEL AND CADMIUM BY VEGETABLES GROWN ON SOIL AMENDED WITH DIFFERENT SEWAGE SLUDGES.
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
R. N. Singh, and R. F. Keefer.
Agriculture, Ecosystems and Environment AEENDO, Vol. 25, No. 1, p 27-38, January 1989. 9 fig, 2 tab, 15 ref.

Descriptors: *Wastewater disposal, *Sludge utilization, *Sludge, *Wastewater, *Path of pollutants, *Nickel, *Cadmium, *Vegetable crops, *Crop production, Carrots, Kale, Beans, Radishes.

Four sewage sludges were applied at 90 and 180 t/ha as a single application in 1976 to a sandy loam soil and radish (Raphanus sativus L. cv. 'White icicle'), carrots (Daucus carota L. cv. 'Chantenay'), cabbage (Brassica oleracea var. capitaita L. cv. 'Market Topper'), kale (Brassica oleracea var. acephala L.), green bush beans (Phaseolus vulgaris L. cv. 'Tenderette') and tomato (Lycopersicon esculentum L. cv. 'West Virginia '63') were grown for five successive years. Cadmium concentrations in the edible parts of plants from sludge treated plots were usually less than 1.0 mg/kg. In radish leaves from plots receiving a sludge with 20 mg of Cd/kg, Cd was present at 4, 2, <1, <1, and 2 mg/kg for the years 1,2, 3, 4, and 5, respectively. Some Cd became available to crops during the fifth growing season. Nickel from two sludges, which were high in water soluble Ni, was available in significantly greater amounts than the control for 5 years for radish roots, radish leaves, and green beans. Some Ni from the same two sludges was also available after the first year and found in carrot roots, cabbage, kale and tomato fruit. Availability of metals from sludges is usually high during the application year with a steady decrease in availability with time. This did not happen for Cd and Ni in this study. Extractability of metals from sludges with water was useful in evaluating uptake of Ni but not Cd by vegetables. Better ways to characterize the chemical form of metals in sewage sludge are needed to predict uptake into edible crops. (Author's abstract)
W90-00430

LIMITATION AND FEASIBILITY OF THE LAND DISPOSAL OF ORGANIC SOLVENT-CONTAMINATED WASTES.
Illinois State Geological Survey Div., Champaign.
W. R. Roy, R. A. Griffin, J. K. Mitchell, and R. A. Mitchell.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 225-231, May-June 1989. 3 fig, 2 tab, 9 ref.

Descriptors: *Model studies, *Waste disposal, *Land disposal, *Solid wastes, *Organic wastes, *Hydrocarbons, *Groundwater pollution, Refrigerants, Solvents.

The limitations and feasibility of the land disposal of solid wastes containing organic solvents and refrigerants (chlorinated hydrocarbons) were investigated by evaluating the attenuation capacity of a hypothetical waste-disposal site by numerical modeling. The basic theorem of this approach was that the land disposal of wastes would be environmentally acceptable if subsurface attenuation reduced groundwater concentrations of organic concentrations of organic compounds to concentrations that were less than health-based, water-quality criteria. Computer simulations indicated that the predicted concentrations of 13 of 33 organic compounds in groundwater would be less than their health-based criteria. Therefore, solid wastes containing these compounds could be safely disposed at the site. The attenuation capacity of the site was insufficient to reduce concentrations of four compounds to safe levels without limiting the amount of mass available to leach into groundwater. Threshold masses based on time-dependent migration simulations were estimated for these compounds. The remaining 16 compounds, which consisted mainly of chlorinated hydrocarbons and fluorocarbons could not be safely landfilled without severe restrictions on the amounts disposed. These organic compounds were candidates to ban from land disposal. (Author's abstract)
W90-00450

INNOVATIVE HYDROGEOLOGIC SETTING FOR DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES.
H. E. Legrand.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 233-239, May-June 1989. 3 fig, 12 ref.

Descriptors: *Waste disposal, *Path of pollutants, *Geohydrology, *Hydrology, *Geology, *Radioisotopes, *Radioactive wastes, Groundwater pollution, Peedee Formation.

A unique, composite hydrogeologic setting is described to assess the likely behavior of radioisotopes in the disposal zone lying below land surface in the flat hinterland of southeastern North Carolina. This environment is favorable for safe and economical disposal of low-level radioactive wastes, partly because of the absence of vertical and horizontal groundwater gradients representing a nonflow (or null) zone. The null setting is localized 30 to 75 feet below land surface and to areas where glaconitic sandy clays of the Peedee Formation lie under less than 25 feet of surficial sandy clays; the Peedee contains nearly stagnant brackish groundwater slightly below the proposed disposal zone. Issues to overcome include: (1) demonstrating better combined safety and economical features over conventional and prescribed settings, (2) dewatering the low-permeability disposal zone for the 20-year operational period, and (3) changing rules to allow disposal slightly below the zone in which the normal water table occurs. Favorable site characteristics of the key setting are: (1) no major aquifer to contaminate, (2) no surface streams or lakes to contaminate, (3) optimal ion exchange and sorptive capacity (clay and glauconite pellets), (4) no appreciable or distinctive vertical and horizontal gradients, (5) no elongated contaminated plume to develop, (6) no surface erosion, (7) a capable setting for injection of potential contaminated water into deep brackish water wells, if needed and allowed, (8) minimum problems of the 'overfilled bathtub effect', (9) no apparent long-term harmful environmental impact (normal water table would be restored after the 20-year period), (10) relatively inexpensive disposal (engineered barriers not needed and desired), (11) simple and relatively inexpensive monitoring, (12) large tracts of land likely available, and (13) sparse population. In spite of legal and political obstacles to shallow land burial, the null setting described is a capable hydrogeological post to contain low-level radioactive wastes. The setting may have safety and economic advantages over selected sites in eastern North America and over innovative technological experiences in Europe. (Author's abstract)
W90-00451

APPLICATION OF HEADSPACE ANALYSIS AND AOX-MEASUREMENT TO LEACHATE FROM HAZARDOUS WASTE LANDFILLS.
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-00479

NITROGEN TRANSFORMATION OF WASTEWATER FROM A SEA-BASED SOLID WASTE DISPOSAL SITE AND THE INFLUENCE OF BENTHAL MUD ON ITS DENITRIFICATION.
Osaka City Inst. of Public Health and Environmental Sciences (Japan). Dept. of Environmental Technology.
I. Fukunaga, O. Yamamoto, K. Takamizawa, and Z. Inoue.
Environmental Technology Letters ETLEDB, Vol. 10, No. 3, p 283-290, March 1989. 4 fig, 3 tab, 14 ref.

Descriptors: *Nitrogen, *Wastewater disposal, *Marine sediments, *Biodegradation, *Denitrification, Nutrient removal, Nitrites, Nitrates, Ammonia, Nitrification, Model studies, Kinetics.

Factors affecting the rate of transformation of nitrogen in wastewater from a sea-based waste disposal site were tested with two types of wastewater, two different systems and three water temperatures. A dynamic biological model was formulated to predict the extent of nitrogen transformation by nitrification and denitrification in a sea-based solid waste disposal site. The total nitrogen content of raw Type A wastewater was 101 milligrams/liter. This concentration was reduced gradually by denitrification in the water-sediment system at the rate of 1.58 milligrams/liter/day at 28 C, 1.48 milligrams/liter/day at 20 C and 1.48 milligrams/liter/day at 10 C during the initial 5 wk. Benthal mud plays an important role in the denitrification of wastewater. In the initial two weeks, the nitrification rates of ammonia-nitrogen to nitrite-nitrogen were 1.44 milligrams/liter/day at 28 C, 0.54 milligrams/liter/day at 20 C and 0.26 milligrams/liter/day at 10 C. These biological nitrification and denitrification reactions followed first-order kinetics. Based on these results, a dynamic biological model of these processes was formulated incorporating first-order reaction kinetics. By fitting experimental data to this model using the Runge-Kutta method with Gill's modification, the extent of nitrification and denitrification of wastewater can be predicted for sea-based waste disposal sites. (Author's abstract)
W90-00491

GLYCERIA MAXIMA FOR WASTEWATER NUTRIENT REMOVAL AND FORAGE PRODUCTION.
Linkoeping Univ. (Sweden). Dept. of Water and Environmental Research.
For primary bibliographic entry see Field 5D.
W90-00521

INFLUENCE OF CATTLE-FEEDLOT MANURE ON AGGREGATE STABILITY, PLASTIC LIMIT AND WATER RELATIONS OF THREE SOILS IN NORTH-CENTRAL ITALY.
Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
J. S. C. Mbagwu.
Biological Wastes BIWAED, Vol. 28, No. 4, p 257-269, 1989. 1 fig, 6 tab, 34 ref.

Descriptors: *Waste utilization, *Waste disposal, *Feedlot wastes, *Soil physical properties, *Soil moisture retention, *Soil stability, *Soil texture, *Italy, Manure, Sand, Clays, Loam, Organic matter.

The effects of incorporating mature cattle-feedlot manure on some physical properties of soil were studied in the laboratory using three soils (a sandy loam from Lamporecchio, a clay from Vicarello and a sandy clay loam from Cremona) and different manure additions (control, 2, 4, 6, and 10%). Manure addition increases the water-holding and available water capacities of all the three soils but that with the highest amount of clay showed the lowest relative improvement. Increasing manure rates also progressively increased the soils plastic limits. At the 10% manure addition, relative improvements over the control were 34, 25, and 33% for the Lamporecchio, Vicarello and Cremona soils, respectively. In the Lamporecchio soil, aggregate stability to water increased with higher manure additions, while in the Cremona soil maximum stability was obtained at about 5% manure. In the clay Vicarello soil, however, aggregate stability decreased with increasing manure. With 2% manure the relative increase in residual organic carbon was highest for the soil with the lowest inherent organic matter level, and varied in the order: Lamporecchio > Vicarello > Cremona.

Variations in residual organic carbon contents of these soils accounted for most of the variabilities in all the measured physical properties. (Author's abstract)
W90-00531

WATER TREATMENT SLUDGE INFLUENCE ON THE GROWTH OF SORGHUM-SUDANGRASS.
Colorado State Univ., Fort Collins. Dept. of Agronomy.
D. M. Heil, and K. A. Barbarick.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 292-298, Jul-Sep 1989. 4 fig, 8 tab, 20 ref.

Descriptors: *Sludge disposal, *Iron, *Aluminum, *Sludge utilization, *Soil contamination, Phosphorus, Sorghum, Sudangrass, Fixation capacity, Hydrogen ion concentration, Soil types, Crop yield.

Disposal of water treatment sludges (freshwater coagulant sludges), which are primarily amorphous Fe and Al compounds, poses a management problem for most municipalities in Colorado and other states. Previous studies indicate that water treatment sludges have a high capacity to fix P and that plant P deficiencies develop when plants are grown in sludge-soil mixtures. This research was initiated to determine acceptable application rates of three types of water treatment sludges added to the Colby (Ustic Torriorthent; pH 7.5) and Red Feather (Lithic Cryoboralf; pH 5.5) soils. A greenhouse study was conducted utilizing mixtures of an alum, iron, or organic polymer sludge combined with each of the two soils at rates of 0, 5, 10, 15, 20, and 25 g/kg. Three cuttings of sorghum-sudangrass (Sorghum bicolor L. Moench 'NB280S'-S. sudanense (Piper) Stapf) were taken. The Langmuir adsorption isotherm approach gave an accurate prediction of the relative fixation capacity of different sludges and consequently the effect of different sludge rates on P uptake by plants. Total plant yield and plant uptake data indicated that positive plant growth responses to sludge above those in the control were the result of improved Fe availability in the Colby soil, and possibly increased soil pH in the Red Feather soil. Yields declined at higher sludge application rates (15-25 g/kg) as compared to low application rates (5-10 g/kg) probably due to increased P fixation by sludge. Plant concentrations of Al, Cu, Mn, Ni, and Pb were not high enough to decrease plant growth; however, Cd concentrations associated with 20 and 25 g alum sludge per kg Red Feather soil were greater than 2 mg/kg. This is the upper limit reported for normal concentrations in plants and it may pose a threat to livestock that consume this forage. (Author's abstract)
W90-00566

HEAVY METAL ACCUMULATION IN SMALL MAMMALS FOLLOWING SEWAGE SLUDGE APPLICATION TO FORESTS.
Washington Univ., Seattle. Wildlife Science Group.
L. J . Hegstrom, and S. D. West.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 345-349, Jul-Sep 1989. 3 tab, 28 ref.

Descriptors: *Sludge disposal, *Heavy metals, *Bioaccumulation, *Cadmium, *Lead, *Zinc, *Copper, *Shrew, *Mice, *Washington, Liver, Kidneys, Animal pathology.

The application of sewage sludge to forested land as a fertilizer may result in the transfer of heavy metals from sludge to wildlife. Levels of four Heavy metals (Cd, Pb, Zn, and Cu) were measured in livers and kidneys of insectivorous Trowbridge's shrews (Sorex trowbridgii) and shrew-moles (Nertotrichus gibbsii), and granivorous deer mice (Peromyscus maniculatus) from sludge-treated and untreated sites at Charles Lathrop Pack Forest, located near Eatonville, WA. Heavy metal levels were higher in the organs of Trowbridge's shrew from sludge-treated areas than in those from untreated areas. Only Cd was elevated in both organs of the deer mouse. Shrew-moles from sludge-treated sites had higher levels of Cd and Pb, but not Zn or Cu, than those from untreated sites. In general, heavy metal levels in the three species from control sites at Pack Forest were similar to levels found in animals from five other control sites in western Washington. Samples of liver and kidney tissue from Trowbridge's shrews were examined for evidence of heavy metal-induced lesions. Despite the high levels of heavy metals found in Trowbridge's shrews, no lesions were found in their organs. (Author's abstract)
W90-00570

SOURCES OF ERROR IN ANALYSIS OF MUNICIPAL SLUDGES AND SLUDGE-AMENDED SOILS FOR DI(2-ETHYLHEXYL) PHTHALATE.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 7B.
W90-00572

MERCURY CONCENTRATIONS IN FISH FROM CONTAMINATED AREAS IN SCOTTISH WATERS.
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W90-00636

ZINC MOVEMENT IN SEWAGE-SLUDGE-TREATED SOILS AS INFLUENCED BY SOIL PROPERTIES, IRRIGATION WATER QUALITY, AND SOIL MOISTURE LEVEL.
Kansas State Geological Survey, Lawrence.
J. E. Welch, and L. J. Lund.
Soil Science SOSCAK, Vol. 147, No. 3, p 208-214, March 1989. 8 tab, 20 ref.

Descriptors: *Sludge disposal, *Soil contamination, *Heavy metals, *Zinc, *Path of pollutants, *Soil columns, Digested sludge, Soil water, Regression analysis, Soil properties, Hydrogen ion concentration, Wastewater disposal, Leaching, Saturation, Irrigation water, Water quality.

A problem associated with sludge application to land is the fate of heavy metals contained within many sludges. A soil column study was conducted to assess the movement of zinc in sewage-sludge-amended soils. Variables investigated were soil properties, irrigation water quality, and soil moisture level. Bulk samples of the surface layer of six soil series were packed into columns, and an anaerobically-digested municipal sewage sludge was incorporated into the top of each. Moisture levels of saturation and unsaturation were maintained and were leached with two waters of different quality. Zinc movement was evaluated by mass balance accounting and correlation and regression analysis. Zinc movement in the unsaturated column ranged from 3-30 centimeters. The difference in irrigation water quality did not have an effect on zinc movement. Most of the zinc applied to the unsaturated columns remained in the sludge-amended soil layer. The mean final soil pH values decreased in the order: saturated columns = sludge-amended soil layer > untreated soils > unsaturated columns. Both total zinc leached from the sludge-amended soil layer and depth of zinc movement were correlated negatively. Multiple linear regression analysis showed that the final pH accounted for 72% of the variation in the total amounts of zinc leached from the sludge-amended soil layer of the unsaturated columns and accounted for 82% of the variation in the depth of zinc movement among the unsaturated columns. A significant correlation was not found between zinc and organic carbon in soil solutions, but a significant negative correlation was found between pH and zinc. (Author's abstract)
W90-00640

DESIGN OF WASTEWATER STORAGE PONDS AT LAND TREATMENT SITES. II: EQUILIBRIUM STORAGE PERFORMANCE FUNCTIONS.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
S. G. Buchberger, and D. R. Maidment.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 704-724, August 1989. 4 fig, 2 tab, 16 ref.

Descriptors: *Land treatment, *Land disposal, *Wastewater treatment, *Wastewater disposal, *Monte Carlo method, Simulation analysis, Stochastic process, Design criteria.

A new reliability-based method is presented to size a storage pond at a land treatment site operated for the disposal of municipal wastewater. Reliability is defined as the probability that wastewater levels remain below the pond freeboard zone. Starting with the mass conservation principle and the theorem of total probability, an integral equation representing the cumulative distribution function of wastewater storage levels is developed. This equation is solved with Monte Carlo simulation, a technique often used in stochastic reservoir analysis. Results are presented on dimensionless design charts called equilibrium storage performance functions which show the steady-state cumulative distribution function of wastewater levels in a storage facility of specified capacity. An example illustrates how the equilibrium storage performance function can be used to design a wastewater storage pond that meets a specified annual reliability. (Author's abstract)
W90-00655

EVALUATION OF ON-SITE WASTE DISPOSAL SYSTEM FOR NITROGEN REDUCTION.
Anne Arundel County Dept. of Health, Annapolis, MD.
R. J. Piluk, and O. J. Hao.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 725-740, August 1989. 7 fig, 4 tab, 29 ref.

Descriptors: *Wastewater disposal, *Nitrates, *Nitrogen removal, *Denitrification, Groundwater pollution, Water pollution prevention, Filtration, Adsorption, Wastewater treatment.

One of the environmental concerns associated with on-site wastewater disposal is nitrate contamination of groundwater. An experimental on-site wastewater disposal system with nitrogen-reducing capability was designed and monitored. Incorporated into the system are two fixed-film reactors: a nitrification/denitrification (N/D) tank, and a polishing filter. Recirculated denitrified effluent sprayed onto the sand filter portion of the N/D tank is nitrified and the nitrified effluent is then mixed with septic tank effluent in the submerged gravel section for denitrification. The remaining portion of the denitrified effluent enters a polishing filter before final discharge into groundwater. With a recirculation ratio of 3.3, the overall reduction in total nitrogen through the N/D tank was approximately 70%. The N/D component of the system also achieved a reduction in BOD, COD, and suspended solids of 87, 80, and 84%, respectively. With the polishing filter, further enhanced removal of these pollutants was achieved, including a 5-log reduction of fecal coliform. Using the N/D tank as a pretreatment unit for a soil adsorption system may not only reduce the levels of total nitrogen entering the system but may also extend the life of the system. (Author's abstract)
W90-00656

DEVELOPMENT AND DESIGN OF SLUDGE FREEZING BEDS.
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Martel.
Journal of Environmental Engineering JOEEDR, Vol. 115, No. 4, p 799-808, August 1989. 2 fig, 3 tab, 22 ref, append.

Descriptors: *Activated sludge, *Wastewater treatment, *Cold regions, *Dewatering, *Sludge drying, *Freezing, Freeze-thaw tests, Thawing, Water treatment, Design criteria, Convection, Heat transfer, Sludge thickening.

A new unit operation called a sludge freezing bed is proposed for dewatering sludges produced by treatment facilities in cold regions. This unit operation uses natural freeze-thaw to condition the

sludge for dewatering. It can dewater all types of aqueous sludges up to a depth of 2.0 m. Basic construction details are identified, and procedures for operating the bed are discussed. The bed is designed to apply sludge in several thin layers rather than a single thick layer. The bed is covered to prevent snow and rain from entering it. The sides of the bed are left open to allow free air circulation. Equations for predicting the design depth are presented along with an example of how they can be used. Convection was found to be the controlling heat transfer mechanism during freezing. Solar radiation, ambient air temperature, and the thermal conductivity of the settled sludge layer over the frozen sludge are important parameters controlling the thawing rate. Data from various sludge freezing operations indicate that the design equations are valid. (Author's abstract)
W90-00661

WATER STORAGE CAPACITY OF WETLAND USED FOR WASTEWATER TREATMENT.
George Mason Univ., Fairfax, VA. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W90-00663

IMPROVEMENTS IN SOIL ABSORPTION TRENCH DESIGN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W90-00665

HYDRAULIC CONDUCTIVITY OF THREE LANDFILL CLAY LINERS.
Wisconsin Dept. of Natural Resources, Madison.
M. E. Gordon, P. M. Huebner, and T. J. Miazga.
Journal of Environmental Engineering JOEEDR, Vol. 155, No. 4, p 1148-1160, August 1989. 3 fig, 10 tab, 10 ref.

Descriptors: *Water pollution prevention, *Clays, *Linings, *Lysimeters, *Leachates, *Hydraulic conductivity, *Landfills, Monitoring, Aeration zone, Seepage, Leakage, Case studies.

Clay liners have been used as a means of leachate containment at landfills in Wisconsin for < 10 yr. Many of these liners are 1.22-1.52-m (4-5 ft) thick and their construction is well documented. Since 1980, the Wisconsin Department of Natural Resources has required collection basin lysimeters to be installed at most clay-lined sites to measure the quality and quantity of leakage from a discrete portion of the liner. These devices were initially required to provide a method for monitoring soil moisture in the unsaturated zone beneath the clay liners because in most cases suction lysimeters had not functioned properly. More recently, volume measurements from regularly sampled lysimeters have been used to estimate field hydraulic conductivity of clay liners. Field hydraulic conductivities calculated from the measured rate of seepage into eight separate lysimeters at three operating landfills is always less than .0000007 cm/sec. (Author's abstract)
W90-00666

CERAMIC PROCESSING OF POLLUTED DREDGED MUD.
C.S.O., Den Dolder (Netherlands).
C. J. Schouten, and M. C. Rang.
Hydrobiologia HYDRB8, Vol. 176/17, p 419-430, July 3, 1989. 3 fig, 8 tab, 10 ref.

Descriptors: *Waste disposal, *Mud, *Recycling, *Construction materials, Leaching, Heavy metals, Ceramic processing.

Results of an investigation into the feasibility of ceramically processing severely polluted dredged muds are presented. Ceramic processing of polluted dredged muds binds and immobilizes the heavy metals. It not only destroys the organic micropollutants; the leaching of heavy metals is reduced by ceramic bonding and the end-product is a hard, lightweight gravel-size particulate, useful as a building material. Extensive tests were carried out on the leaching behavior of the ceramic products and the results showed little or no differences in comparison with other commonly used building materials; the results are better than those of aggregates made from pulverized fuel ashes. From the leaching tests, it may be concluded that, with carefully controlled manufacture, there are no environmental limitations to the application of ceramic products made of polluted dredge muds. In contrast to other heavy metals, arsenic and vanadium diffuse to the surface of the products during the sintering process and are easily leached with water under pH-neutral conditions. (Miller-PTT)
W90-00729

HOW TO MONITOR GROUNDWATER AT A MUNICIPAL SOLID WASTE FACILITY.
Joyce Engineering, Inc., Princeton, WV.
For primary bibliographic entry see Field 5A.
W90-00796

CONCENTRATIONS AND FATE OF LINEAR ALKYLBENZENE SULPHONATE IN SLUDGE AMENDED SOILS.
Soap and Detergent Industry Association, Hayes (England).
For primary bibliographic entry see Field 5B.
W90-00833

USE OF SLUDGE-ONLY LANDFILLS AS HISTORICAL RECORDS OF PERSISTENT ORGANIC CHEMICALS AND HEAVY METALS IN SEWAGE SLUDGE.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
P. D. Capel, T. Lichtensteiger, and P. H. Brunner.
Water Research WATRAG, Vol. 23, No. 4, p 525-527, April 1989. 2 fig, 1 tab, 14 ref.

Descriptors: *Sludge disposal, *Landfills, *History, *Metals, *Organic compounds, Polychlorinated biphenyls, Cadmium.

The suggestion is made here that the historical chemical record contained in sludge-only landfills can reflect the use and disposal of many types of chemical species. The level of pollutants entering treatment plants are a function of industrial and domestic use and release. A majority of the persistent, hydrophobic organic compounds and heavy metals which enter a treatment plant find their way to the sludge. Landfills which have been used only for sewage sludge disposal for a known and finite period of time may provide adequate local historical records for many pollutants. Samples from sludge-ponds of three German landfills with well known periods of use (before 1956-1986) were analyzed for PCBs and Cd. The results are in general agreement with the known use and release patterns for these two chemical species. The limitations of using sludge-only landfills as historical records is dependent on the sewage treatment plant efficiency and the properties of both the landfill and the pollutant. (Author's abstract)
W90-00915

GROUNDWATER POLLUTION AND THE DISPOSAL OF HAZARDOUS AND RADIOACTIVE WASTES.
J. D. Mather.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 31-35, February 1989. 13 ref.

Descriptors: *Water pollution prevention, *Waste disposal, *Radioactive waste disposal, *Hazardous waste disposal, Landfills, Groundwater pollution.

The demand for 'Rolls-Royce' solutions to the disposal of hazardous and radioactive wastes has seen a continuing move towards more sophisticated disposal concepts. If a disposal site for radioactive wastes meets the strict requirements laid down by Government departments it is difficult to see why there should be any impact to groundwater of concern to the water industry. Hazardous wastes are a much more significant problem, and the large size of many landfills, other pressures on groundwater quality and current EC directives are all contributing to a move away from the use of 'dilute and disperse' sites. It is argued that the long-term performance of containment sites needs to be carefully evaluated over timescales of 2-3 decades, as over such periods a correctly-managed policy of 'dilute and disperse' may result in less of an overall impact to the environment than a policy of 'concentrate and contain'. (Author's abstract)
W90-00926

5F. Water Treatment and Quality Alteration

DRINKING WATER CRITERIA DOCUMENT FOR POLYCHLORINATED BIPHENYLS (PCBS): 1987 REVIEW OF THE DRAFT FINAL.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
For primary bibliographic entry see Field 5G.
W90-00085

REVIEW OF THE SELENIUM HEALTH CRITERIA DOCUMENT.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
For primary bibliographic entry see Field 5G.
W90-00090

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W90-00092

POINT-OF-USE/POINT-OF-ENTRY SYSTEMS FOR REMOVING VOCS FROM DRINKING WATER.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
B. W. Lykins, and J. H. Baier.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-120844. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/203, November 1988. 39p, 10 fig, 9 tab, 40 ref.

Descriptors: *Water treatment, *Volatile organic compounds, *Drinking water, Potable water, Water quality control, Organic compounds, Water pollution sources, Administrative regulations.

Where available, centralized treatment is the recommended method for producing potable water. Many homes, however, cannot connect to a centralized water treatment system leaving them with no other alternative but to treat their own water. Point-of-use/point-of-entry (POU/POE) systems are effective for removing organic contaminants from drinking water if operated and maintained properly. Treatment methods discussed in this report include: activated carbon, reverse osmosis, distillation, ozone, UV irradiation, and air stripping. More homeowners with private drinking water sources are aware of the potential of contamination of these sources and are willing to have them tested. This has led to the identification of many organic compounds in these private drinking water sources. As testing continues, the potential exists for identifying more private drinking water sources that have been contaminated by agricultural use, industrial solvents, leaking gasoline tanks, and hazardous waste sites. Various treatment options are available to the homeowner for removing VOCs although activated carbon is the most widely used POU/POE system. With an increase in the number of households using POU/POE systems, many health departments and other agencies have implemented or they are giving serious consideration to centralized control of these systems. This control allows them to establish treatment requirements, operation and maintenance requirements, and proper waste disposal. (Lantz-PTT)
W90-00137

EVALUATION OF MILITARY FIELD-WATER QUALITY. VOLUME 4. HEALTH CRITERIA AND RECOMMENDATIONS FOR STANDARDS. PART 1: CHEMICALS AND PROPERTIES OF MILITARY CONCERN ASSOCIATED WITH NATURAL AND ANTHROPOGENIC SOURCES.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5G.
W90-00163

WATER AND WASTEWATER FINANCE AND PRICING.
Young (Arthur) and Co., Charlotte, NC.
For primary bibliographic entry see Field 5D.
W90-00176

HEALTH EFFECTS OF DRINKING WATER TREATMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
Lewis Publishers, Chelsea, MI. 1989. 146p.

Descriptors: *Public health, *Drinking water, *Water treatment, Disinfection, Chlorination, Trihalomethanes, Chemical treatment, Potable water, Physical treatment, Corrosion, Ion exchange, Reverse osmosis, Activated carbon, Volatility, Human diseases, Risk assessment, Population exposure.

Mechanical treatment (e.g., filtration) and disinfection of drinking water have dramatically reduced waterborne diseases such as typhoid fever, cholera, hepatitis, and other enteric virus infections in the U.S. population. With widespread chlorination, however, came chlorination by-products such as chloroform, chloroacetic acids, and chlorinated phenols that may pose some cancer and other health risks to the general population. To address this issue, Congress included in the Safe Drinking Water Act Amendments of 1986 a provision requiring the US EPA to assess and compare the health effects associated with water treatment chemicals and their by-products to contaminants found in untreated drinking water supplies. This book focuses on disinfection since this is of greatest public concern and is the most widespread treatment technique employed on a national basis. To a lesser degree, the book also examines the health risks from the other major treatment technologies. The book also addresses the challenges that water treatment systems face when the removal of one contaminant leads to the formation of others or when optimizing treatment to control one substance causes others to increase (e.g., low pH reduces trihalomethanes but increases corrosion). The book is divided into seven chapters. Chapter 1 assesses raw water quality, and Chapter 2 provides an overview of drinking water treatment, which usually involves various treatments working in concert rather than a single technology. Chapters 3 through 7 present the treatment technologies (disinfection, coagulation, flocculation, sedimentation, filtration, corrosion and pH control, ion exchange, lime softening, reverse osmosis, activated carbon adsorption, and air stripping) and their associated health risks (from substances either added or removed due to treatment). These chapters are organized according to treatment type, since the majority of chemicals of concern are treatment chemicals or by-products of treatment. In essence, the treatments served as a focal point for analyzing the risks associated with the introduction and removal of chemicals from drinking water. (Lantz-PTT)
W90-00177

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY, 1978-SEPTEMBER, 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-869664, Price codes: N01 in paper copy, N01 in microfiche. October 1988. 44p. Supercedes PB87-851960.

Descriptors: *Drinking water, *Heavy metals, *Public health, *Bibliographies, *Water conveyance, Plumbing, Groundwater pollution, Acid rain effects, Landfills, Leachates, Metals, Water pollution effects, Toxicity, Water quality standards, Standards, Regulations, Laboratory studies.

This bibliography contains 96 citations concerning the public health aspects and documented studies of heavy metal pollutants in drinking water; 12 of these citations are new entries to the previous edition. Topics include human exposure studies and the toxicological effects incurred by ingestion. Prolonged exposure and quantification factors and effects, federal and state regulations and standards, and laboratory animal studies are discussed. Sources from landfill contamination of groundwater, acid precipitation contributions to groundwater pollution, and corrosion by-products in residential plumbing and public water supply transport systems are examined. (Author's abstract)
W90-00179

COMPARISONS OF VARIOUS FILTRATION MEDIA.
Environmental Protection Agency, Cincinnati, OH. Microbiological Treatment Branch.
G. S. Logsdon.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-118764. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/217, October 1988. 22p, 4 tab, 23 ref.

Descriptors: *Filtration, *Water treatment, *Filter media, Diatomaceous earth, Sand, Coagulation, Turbidity, Electrical properties, Anthracite, Ilmenite.

The use of filtering materials in diatomaceous earth (DE) filtration, slow sand filtration, and coagulation--rapid rate filtration, are reviewed. For DE filtration, increased effluent clarity (lower turbidity) is generally attained at the expense of increased rates of head loss increase. Changing the surface characteristics of DE from electronegative to electropositive permits use of coarser grades of DE for effective removal of fine particles. An important consideration in selecting media for slow sand filtration is whether to use media mined and prepared by a filter media processor, or whether to use a locally quarried and processed material as filter media. Trends in filter media design for plants employing coagulation and rapid rate filtration have varied over the decades. Practice has evolved from use of sand and anthracite and fine but dense garnet of ilmenite. Recently a 600 million gallon per day direct filtration plant was build with very deep beds consisting of a single medium--anthracite. Filter bed design is continuing to evolve and change. (Lantz-PTT)
W90-00238

TRACE SUBSTANCES PRESENT AS CHLORINATION BY-PRODUCTS IN DRINKING AND PROCESS WATERS.
Oak Ridge National Lab., TN. Waste Management Technology Center.
R. L. Jolley.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-012923. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-8805159--1, (1988). 10p, 2 fig, 2 tab, 20 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Pollutant identification, *Drinking water, *Water treatment, *Water analysis, *Chlorination, *Wastewater treatment, Hydrochloric acid, Organic compounds, Chlorinated hydrocarbons, Disinfection, Trihalamethanes.

Chlorination is a process commonly used for disinfection of potable water supplies, for the treatment of a variety of process waters such as wastewater and cooling waters, and for many industrial processes such as paper pulp bleaching. Such use is based on the reactive and oxidative properties of aqueous chlorine species in which the chlorine is present at a valence state of plus one (i.e., Cl(+) in HOCl or Cl2). Both HOCl and Cl2 are powerful oxidants and appear to be the principal agents responsible for the chlorine substitution reactions. During the last 15 years, increasing attention has been focused on the formation of chloro-organic by-products during the chlorination process, especially in drinking water because of public health concern regarding the toxicological properties of halogenated organics. This paper briefly reviews the chemistry of chlorine germane to the formation of chloro-organics and summarizes some of the more recent development, such as: chloro-organic by-products from the chlorination of drinking water and chloro-organics produced during the bleaching of paper pulp. (Lantz-PTT)
W90-00242

GRANULAR ACTIVATED CARBON ADSORPTION WITH ON-SITE INFRARED FURNACE REACTIVATION.
Jefferson Parish Dept. of Public Utilities, LA.
W. E. Koffskey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-110134. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/058, September 1988. 157p, 38 fig, 50 tab, 6 ref, append. EPA Contract CS806925.

Descriptors: *Recycling, *Disinfection, *Water treatment, *Chlorination, *Activated carbon, *Adsorption, *Wastewater treatment, Infrared radiation, Costs, Maintenance, Water pollution prevention, Microbiological studies, Bacteria, Organic compounds, Dioxin.

The costs associated with the design, construction, operation, and maintenance of three 1-million gallons per day (mgd) granular activated carbon (GAC) pressure contactors and reactivation system were evaluated over a 2.4 yr operational period. The reactivation system was comprised of a Shirrco infrared reactivation furnace, three GAC storage tanks, and a water slurry GAC transport system. Operation and maintenance costs, excluding amortized capital costs, were determined to be 20 cents/lb of reactivated GAC or 14 cents/1,000 gal of treated water. Adsorption performance of the reactivated GAC was equal to or greater than that of virgin GAC for all parameters monitored. The GAC loss observed during reactivation averaged 8.6% and was comprised of 7.1% reactivation loss and 1.5% transport loss. The effluent streams of the infrared reactivation furnace were examined for the presence of polychlorinated dibenzodioxins and polychlorinated dibenzofurans. While trace levels of some of these substances were observed, a risk assessment indicated a maximum life time risk of three in 1 billion for the existing facility. The GAC filter effluent contained a mean heterotrophic plate count (HPC) of 3,137 colony forming units (CFU)/ml, which was comprised of approximately 50% Pseudomonas and 25% gram positive bacteria. While the HPC on the GAC surface was considerably higher, similar bacterial species were observed. (Author's abstract)
W90-00248

ADVANCED INFORMATION SYSTEM OF WATERWORKS, (IN JAPANESE).
Available from National Technical Information Service, Springfield, VA 22161 as PB88-253141/AS. Price codes: E04 in paper copy, A01 in microfiche. 1988. 88p. English summary.

Descriptors: *Water treatment facilities, *Data storage and retrieval, *Data processing, *Computers, Automation, Information systems, Control systems.

A water purification and sewage treatment plant is the core of the water industry. The supervisory control system assumes the central role for water purification control, enabling efficient operation of the facilities and overall management of the water and sewage treatment plant. With the increase in information and the growing diversity of that information, high informatization is being required of the supervisory control system (integrated CIE supervisory control system), called 'TOSWACKS'-AD, which interactively combines various controlling and managing computers, instru-

mentation control system, and electrical equipment system. (Author's abstract)
W90-00255

DETERMINATION OF FLUORIDE IONS IN WATER BY CONDUCTOMETRIC TITRATION WITH LANTHANUM NITRATES (DETERMINACAO DE IONS FLUORETO EM AGUAS, POR TITULACAO CONDUTOMETRICA COM NITRATO DE LANTANIO).
Sao Paulo Univ. (Brazil). Inst. de Quimica.
For primary bibliographic entry see Field 5A.
W90-00274

POSSIBLE HEALTH EFFECTS OF HIGH MANGANESE CONCENTRATION IN DRINKING WATER.
Patras Univ. (Greece). School of Health Sciences.
X.G. Kondakis, N. Makris, M. Leotsinidis, and T. Papapetropoulos.
Archives of Environmental Health AEHLAU, Vol. 44, No. 3, p 175-178, May-June 1989. 5 tab, 17 ref.

Descriptors: *Public health, *Manganese, *Drinking water, *Water pollution effects, *Human pathology, Neurological disorders, Greece, Heavy metals.

Three areas in the same region of northwest Peloponnesos, Greece, that had varying concentrations of manganese (Mn) in drinking water were selected for study. The Mn concentrations in areas A, B, and C were 3.6-14.6 microgram/liter, 81.6-252.6 microgram/liter, and 1800-2300 microgram/liter. A random sample (62 in area A, 49 in area B, and 77 in area C) of males and females who were at least 50 years of age were submitted to a thorough neurological examination and their whole-blood Mn and hair Mn concentrations were determined. Although all areas were similar with respect to social and dietary characteristics, significant differences were observed for prevalence of chronic manganese poisoning symptoms and hair Mn concentration. The means (both sexes) of neurological scores were 2.7, 3.9, and 5.2, for areas A, B, and C. Hair Mn concentrations were also significantly different, the means for which were 3.51, 4.49, and 10.99 microgram/g dry weight, (both sexes) for areas A, B, and C. These results indicate that progressive increases of Mn concentration in drinking water are associated with progressively higher prevalences of neurological signs of chronic manganese poisoning and Mn concentration in hair of older persons. (Author's abstract)
W90-00293

INDIRECT SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE IN WATER WITH ZIRCONIUM-SPADNS BY FLOW INJECTION ANALYSIS.
Yarmouk Univ., Irbid (Jordon). Dept. of Chemistry.
A. T. Haj-Hussein, and I. F. Al-Momani.
Analytical Letters ANALBP, Vol. 22, No. 6, p 1581-1599, June 1989. 9 fig, 2 tab, 19 ref. Yarmouk University grant (Project N. 19/88).

Descriptors: *Water treatment, *Water analysis, *Fluorides, *Spectrophotometry, *Chemical analysis, Zirconium-SPADNS, Separation techniques.

The zirconium-SPADNS (z(p-sulfophenylazo)-1,8-dihydroxynaphthalene-3,6-disulfonate) method for the determination of fluoride based on the effect of fluoride ion on the color system, has been adapted to the continuous flow spectrophotometry. A manifold consisting of two lines was used. The decrease in the absorbance of zirconium-SPADNS reagent at 590 nm is linear with fluoride concentration in the range 0.00-3.5 ppm. The method has a detection limit of 0.02 ppm fluoride. At a sampling rate of 50 determinations per hour, the precision was about 1 % relative standard deviation. The method is applied to the determination of fluoride in natural water samples. The good agreement between the results obtained by this method and those obtained by a potentiometric method using a fluoride ion-selective electrode, show that the new method is potentially suitable for routine analysis. The effects of reaction conditions, flow parameters, and interferences on the flow injection analysis spectrophotometric signals are reported. (Author's abstract)
W90-00295

FILTRATION STUDIED WITH ENDOSCOPES.
University Coll., London (England). Dept. of Civil and Municipal Engineering.
K. J. Ives.
Water Research WATRAG, Vol. 23, No. 7, p 861-866, July 1989. 4 fig, 1 tab, 10 ref.

Descriptors: *Water treatment facilities, *Wastewater treatment, *Sand filters, *Filtration, *Endoscopy, Backwash, Video recording.

A new technique uses endoscopes inserted into rapid sand filters to observe directly and dynamically filtration deposition and backwashing phenomena in the filter pores, at magnifications up to 500x. Coupled with normal (25 frames/s) and high speed (200-400 frames/s) TV cameras, video-recordings were made during many filter runs and washing sequences. Several hitherto unreported phenomena were observed in normal rapid filters, continuous countercurrent filtration and Pebble Matrix Filters, such as the formation of lenticular voids in experimental filters, tumbling grains motions with shear gradients and movement patterns during backwashing. The technique has proved useful in observing the evolution of holes in surfacemat deposits; in identify shear gradients in continuous filtration; in demonstrating desirable discontinuities in Pebble Matrix Filtration; and in maintenance inspection of on-site pilot filters. (Author's abstract)
W90-00419

LOW TECHNOLOGY WATER PURIFICATION BY BENTONITE CLAY FLOCCULATION AS PERFORMED IN SUDANESE VILLAGES: BACTERIOLOGICAL EXAMINATIONS.
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
M. Madsen, and J. Schlundt.
Water Research WATRAG, Vol. 23, No. 7, p 873-882, July 1989. 3 fig, 7 tab, 28 ref.

Descriptors: *Drinking water, *Water treatment, *Flocculation, *Bentonite *Bacteria, *Enteric bacteria, *Pathogenic bacteria, Escherichia coli, Vibrio, Streptococcus, Salmonella, Shigella, Sudan, Developing countries.

The effects of a water purification method traditionally used in Sudan to treat turbid waters were studied with respect to removal of fecal indicator bacteria as well as selected enteric bacterial pathogens. Water treatment was performed with natural bentonite clays (rauwaq) from the banks of the Nile, and the technique employed corresponded closely to that used to clarify Nile water in Sudanese villages. Employing various types of waters a primary bacterial reduction of 1-3 log units (90-99.9%) was obtained within the first 1-2 h of flocculation. During the 24 h observation period bacterial multiplication in the water phase occurred consistently for Vibrio cholerae and test organisms belonging to the Enterobacteriaceae group, but not for Streptococcus faecalis and Clostridium perfringens. Some of the conditions influencing the hygienic effects obtained were examined. Water purification by rauwaq flocculation may be a simple and valuable tool improving the hygiene quality of the water and thus reducing the risk of waterborne infections. The method may in particular prove to be useful in rural developing areas where the alternative for the population, in a long time to come, is to drink the water untreated. In recommending the method, though the importance of the time factor must be stressed, and treated water should if possible be consumed within the first hours of purification. (Author's abstract)
W90-00421

INFLUENCE OF CHLORINATION PH AND CHLORINE DOSE ON THE FORMATION OF MUTAGENIC ACTIVITY AND THE STRONG BACTERIAL MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-5(2H)-FURANONE (MX) IN WATER.
Abo Akademi, Turku (Finland). Dept. of Organic Chemistry.
P. Backlund, E. Wondergem, K. Voogd, and A. de Jong.
Chemosphere CMSHAF, Vol. 18, No. 9-10, p 1903-1911, 1989. 2 fig, 29 ref.

Descriptors: *Water treatment, *Chlorination, *Hydrogen ion concentration, *Mutagenicity, Chlorine, Aquatic bacteria, Adsorption, The Netherlands.

Samples from two Dutch raw water sources were chlorinated in the laboratory at different pH's and chlorine doses, and were analyzed for mutagenic activity and the mutagenic compound 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX). Chlorination produced mutagenic activity as well as MX in both waters. The formation of MX was favored by acidic reaction conditions and high chlorine doses, but in waters treated with excess chlorine at pH 9, no MX was detected. The mutagenicity was approximately on the same level after chlorination of both water types but the MX concentration was significantly higher in the water containing mainly humic material. MX was found to be quantitatively extracted from acidified waters by the XAD resin adsorption technique. (Author's abstract)
W90-00478

STUDIES ON THE REMOVAL OF SOME TOXIC METAL IONS: II. REMOVAL OF LEAD AND CADMIUM BY MONTMORILLONITE AND KAOLINITE.
Roorkee Univ. (India). Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W90-00490

MANGANESE AND IRON RELATED PROBLEMS IN AUSTRALIAN WATER SUPPLIES.
Australian Nuclear Science and Technology Organisation, Sutherland.
G. H. Khoe, and T. D. Waite.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 479-490, May 1989. 6 fig, 2 tab, 24 ref.

Descriptors: *Manganese, *Iron, *Water quality control, *Australia, *Drinking water, *Water treatment, Coagulation, Flocculation, Oxidation, Filtration.

Manganese and iron related problems have become a significant water quality issue to water supply authorities in Adelaide, Melbourne, the Gold Coast of Queensland and the urban regions north and south of Sydney, Australia. These problems, in many instances, have been attributed to the extraction of hypolimnetic waters from thermally stratified reservoirs, particularly in the case of relatively productive waters where sedimenting organic detritus provides an adequate food source for oxygen-consuming organisms. The use of multi-level inlet towers may enable selective extraction of oxygenated epilimnetic waters, but such waters, particularly during the summer months, often support high algal populations. In addition, at the onset of winter turnover, high iron and manganese content bottom waters are likely to be mixed with surface waters resulting in a significant reduction in the quality of water entering the treatment plant. Such variability prompted the Wyong Shire Council to introduce artificial aeration of Mardi Dam to improve water quality conditions. Treatment plants operations to reduce the levels of manganese and iron in drinking water include the oxidation of soluble metals to insoluble forms, followed by filtration or flocculation/sedimentation methods. Iron and manganese occur in the distribution system as a deposit of biofilm by microbial processes. Scouring of biofilms may occur from excess flows or higher chlorine doses entering the distribution system. It is recommended that chlorine dioxide levels in the distribution system be suffi-

ciently high to control manganese biofilms. (Geiger-PTT)
W90-00502

BACTERIAL EXTRACELLULAR MATERIAL FROM BREWERY WASTEWATER FOR RAW WATER TREATMENT.
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
M. F. Al-Shahwani, and E. H. Al-Rawi.
Biological Wastes BIWAED, Vol. 28, No. 4, p 271-276, 1989. 2 fig, 1 tab, 12 ref.

Descriptors: *Water treatment, *Coagulation, *Pretreatment of water, *Coagulation, *Flocculation, *Sedimentation, Bacteria, Extracellular material, Brewery wastewater, Fermentation.

Natural bacteria found in brewery wastewater were used to produce bacterial extracellular materials and then used as coagulant aids for raw water treatment. A 5-L fermenter (Gallenkamp) was loaded with 350 ml of wastewater. Twenty-four milligrams per liter (density 1.5 g/ml) of molasses were then added, followed by the adjustment of the pH to 7.00. The following variables were fixed before the run: temperature, 30 C; pH, 7; mixing speed, 7500 rpm; air flow, 5000 cu cm/min; fermentation time, 88 h. The dried bacterial extracellular material (DBEM) was extracted and a dose of 30 mg/L of DBEM was added to raw water from the Tegris River along with the normal dose, 20 mg/L of alum. Preliminary trials showed that the concentration of molasses used in the fermentation gave optimum bacterial growth. The results of the effects of various doses of DBEM and alum show that the highest efficiency performance (i.e. lowest sedimentation time and turbidity) was for alum and DBEM concentrations of 30 mg/L each. At other concentrations the efficiency was variable. It was demonstrated that the settling properties improved due to the development of bigger flocs with DBEM and alum mixtures than with alum alone. (White-Reimer-PTT)
W90-00532

OZONATION BYPRODUCTS: IMPROVEMENT OF AN AQUEOUS-PHASE DERIVATIZATION METHOD FOR THE DETECTION OF FORMALDEHYDE AND OTHER CARBONYL COMPOUNDS FORMED BY THE OZONATION OF DRINKING WATER.
California Univ., Los Angeles. School of Public Health.
W. H. Glaze, M. Koga, and D. Cancilla.
Environmental Science and Technology ESTHAG, Vol. 23, No. 7, p 838-847, July 1989. 11 fig, 8 tab, 33 ref.

Descriptors: *Water analysis, *Ozonation, *Formaldehyde, *Drinking water, *Water treatment, Gas chromatography, Organic carbon, Surface water, Groundwater, Electron capture detector, Mass spectrometry.

A method for the determination of low molecular weight aldehydes in water using aqueous-phase derivatization with O-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine hydrochloride has been improved by the use of high-resolution capillary gas chromatography (GC). Detection limits with GC/ECD (electron capture detector) and GC/MS (mass spectrometer) with selected ion monitoring are in the low microgram per liter (ppb) range. The method has been used to evaluate levels of aldehydes in three surface water treatment plants and one ground water treatment plant before and after ozonation. Aldehydes are increased as a result of ozonation, with formaldehyde being the most prevalent. Most of the aldehydes remain after chemical flocculation, filtration, and chlorination. Higher yields are observed in the plant treating surface water with the highest total organic carbon (TOC) level, but very low yields are observed in a high TOC groundwater. Spiking studies show that the raw groundwater has a very high demand for formaldehyde, suggesting that the aldehydes may be converted into secondary by-products. (Author's abstract)
W90-00537

STUDIES ON FAECAL STREPTOCOCCI IN WELLS WATER NEAR MOSUL CITY.
Mosul Univ. (Iraq). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W90-00543

WATER SUPPLY: QUALITY, ECONOMICS AND PLANNING FOR THE FUTURE.
For primary bibliographic entry see Field 6A.
W90-00650

SEA CONSULTANTS INC, CAMBRIDGE, MA.
S E A Consultants, Inc., Cambridge, MA.
D. F. Reed.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 2, p 86-99, June 1989. 5 fig, 1 tab, 17 ref.

Descriptors: *Radon radioisotopes, *Drinking water, *Water supply, *Groundwater pollution, *Water treatment, *Activated carbon, *Maine, Water pollution effects, Separation techniques.

The EPA is currently developing regulations to limit the radon concentration in public water supplies. Based on the latest scientific evaluations, it appears that the health impact of radon is larger than suggested by guidelines used at the state level. The radon maximum contaminant level being discussed would impact over half of the groundwater supplies in the country and a larger percentage in the New England States. In Friendship, Maine, a public water system was recently placed into operation that uses a bedrock well as a source. High radon levels are treated using granulated activated carbon contactors. Performance testing was completed that provides insight into process effectiveness and the flexibility of GAC to respond to varying loading rates. (Author's abstract)
W90-00653

IMPROVED REMOVALS OF TRIHALOMETHANE PRECURSORS BY SMALL WATER SUPPLY SYSTEMS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
M. R. Collins, T. T. Eighmy, J. M. Fenstermacher, S. K. Spanos, and C. M. Spencer.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 2, p 100-113, June 1989. 7 fig, 1 tab, 24 ref. American Water Works Association Research Foundation 208-86.

Descriptors: *Trihalomethanes, *Sand filters, *Filtration, *Water treatment, *Chlorinated hydrocarbons, Adsorption, Biodegradation, Activated carbon, Chlorination, Separation techniques.

Selected slow sand filter modifications that could enhance the principal removal mechanisms of biodegradation and adsorption and would not compromise the simplicity of the treatment process were explored in research conducted at the University of New Hampshire. The modifications were evaluated for their potential to improve removal of trihalomethanes (THM) precursor material and particulate matter over conventionally operated slow sand filters. The results suggest that those water utilities that are considering slow sand filtration and want to improve THM precursor removals construct filter units that provide the following capabilities: increase biodegradation potential by increasing bacterial populations with filter depth through incorporating a cleaning procedure that harrows the filter media; or increase adsorption removals by adding granular activated carbon or anionic resin as a filter media amendment. Modified slow sand filter units will need to provide the following items for implementation of the preceding recommendations: rubber-tired tractor with special harrow and ready access to the filter bed coupled with an effective filter supernatant drainage system arranged slightly above the media surface; or handling equipment and cleaning basins that transport and regenerate carpets or filter mats of anionic resin that are placed on top of the filter bed. THM precursor removals by slow sand filters may be independent of organic loading rate suggesting that smaller filter units operating at high filtration rates may be used to offset construction costs. However, the savings in construction costs may be lost if an efficient filter cleaning procedure is not correspondingly implemented since increased removal rates will increase head-loss development. (Author's abstract)
W90-00654

USE OF TAILORED BENTONITE FOR SELECTIVE REMOVAL OF ORGANIC POLLUTANTS.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W90-00658

MEMBRANE/OIL STRIPPING OF VOCS FROM WATER IN HOLLOW-FIBER CONTACTOR.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5D.
W90-00659

BREAKTHROUGH CURVES IN GRANULAR MEDIA FILTRATION.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5D.
W90-00660

DEVELOPMENT AND DESIGN OF SLUDGE FREEZING BEDS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5E.
W90-00661

PUMP-CONTROL VALVES PROTECT YOUR WATER SYSTEM.
Bermad Control Valves, Anaheim, CA.
J. Bengtson.
Water Engineering and Management WENMD2, Vol. 136, No. 7, p 42-44, 92-93, July 1989. 5 fig.

Descriptors: *Water treatment, *Hydraulic valves, *Pumps, Hydraulic machinery, Hydraulic equipment, Process control.

Pump-control valves serve a variety of operational and emergency control functions for water systems. When selecting pump-control valves for any water system application basic valve design and control-system design should be considered. Globe-type control valves are easy to control in water distribution applications. Diaphragm actuation is the simplest for globe-type control valves, while electro-hydraulic control systems meet operational requirements best. Two types of electro-hydraulic diaphragm valves are generally accepted as pump-control valves: double-chamber valves and single-chamber valves. In the double-chamber design, four separate pressure-sensing and/or valve-actuation points are provided: main flow (upstream and downstream, and above and below the diaphragm. Within the globe-valve classification, Y-pattern valves offer higher flow with low pressure-loss characteristics while providing minimal adverse fluid-dynamic effects. Booster-pump control valves are installed on a booster pump's discharge to prevent starting and stopping pressure surges. A pressure-sustaining option is one type of control modification available in the booster-pump control-valve design. A deep well pump-control valve arrangement is installed on a T at the pump's discharge. In both booster pump and deep well applications, flow-control valves can be combined with other control-element arrangements to provide such specialized needs as flow-rate control and differential-pressure control. (Geiger-PTT)
W90-00669

ENGINEERING APPROACH TO WATERLINE THRUST RESTRAINT.
New York State Dept. of Transportation, Albany.
For primary bibliographic entry see Field 8A.
W90-00795

IODINE USED AS A WATER-DISINFECTANT IN TURBID WATERS.

Loughborough Univ. of Technology (England). Dept. of Civil Engineering.
K. V. Ellis, and H. B. R. J. van Vree.
Water Research WATRAG, Vol 23, No. 6, p 671-676, June 1989. 9 fig, 3 tab, 11 ref.

Descriptors: *Water treatment, *Disinfection, *Iodine, *Turbidity, *Impaired water use, *Disinfection, Bacteria, Hydrogen ion concentration, Impaired water quality.

Various concentrations of iodine were employed to inactivate faecal indicator bacteria in low quality water at different turbidities in three pH ranges. The results obtained were compared with those of an arbitrarily selected standard of 1.0 mg/L chlorine. Under all the conditions, for which dosages of 4.0 or 8.0 mg/L iodine were used, a water of virtual potable quality was obtained within a 30 min contact period. Under none of the conditions investigated was a dosage of 1.0 mg/L iodine found to be an effective disinfectant while both 1.0 mg/L chlorine and 2.0 mg/L iodine were generally effective in the lowest pH range investigated and at low turbidity but the disinfecting effect in both cases decreased with increasing pH and increasing turbidity. (Author's abstract)
W90-00821

REMOVAL OF THE TYPICAL ISOTOPES OF THE CHERNOBYL FALL-OUT BY CONVENTIONAL WATER TREATMENT.

Brussels Water Board (Belgium).
R. Goossens, A. Delville, J. Genot, R. Halleux, and W. J. Masschelein.
Water Research WATRAG, Vol 23, No. 6, p 693-697, June 1989. 6 fig, 1 tab, 17 ref.

Descriptors: *Water treatment, *Radioisotopes, *Fallout, *Chernobyl, Coagulation, Flocculation, Sand filters.

A classical full-scale treatment scheme including coagulation-flocculation-upflow settling and rapid sand filtration is investigated for its efficiency in removal of trace concentrations of radioactivity, demonstrated by four isotopes. Known activity of each isotope is added to the raw water and a mass balance is established by measuring the activities in the sludge and in the treated water. Maximum removal efficiencies found were 73, 61, 17 and 56% for 103Ru, 58Co, 131I and 134Cs accordingly. A general equation corresponding to a mass transfer mechanism into the sludge has been found. Radiocesium remains fixed on the filtration sand for several months. Decrease of the activity of the isotopes fixed on the sludge occurs according to two mechanisms: bleeding of the sludge and elution of the sludge by uncontaminated water. The latter is a linear function of time depending also on the type of isotope. The results depend on the water treatment scheme, and they enable formulation of general models and prediction of the activity accumulated in the sludge. The model is also applicable in predicting the quality of the treated water when a nuclear accident is occurring and in optimizing the operation of the flocculation-settling during such periods. (Author's abstract)
W90-00824

DETECTION OF ENDOTOXINS IN RECLAIMED AND CONVENTIONALLY TREATED DRINKING WATER.

Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 5A.
W90-00830

CONTINUOUS FLOW METHOD FOR DETERMINATION OF TOTAL TRIHALOMETHANES IN DRINKING WATER WITH MEMBRANE-SEPARATION.

Osaka Univ., Sakai (Japan). Lab. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W90-00831

VARIATIONS IN RAINWATER QUALITY FROM ROOF CATCHMENTS.

Pertanian Malaysia Univ., Serdang. Dept. of Environmental Sciences.
M. I. Yaziz, H. Gunting, N. Sapari, and A. W. Ghazali.
Water Research WATRAG, Vol. 23, No. 6, p 761-765, June 1989. 1 fig, 5 tab, 3 ref.

Descriptors: *Water quality, *Rain, *Catchment basins, *Roof catchment, *Domestic water, *Chemistry of precipitation, *Catchment area, Roofs, Rainwater collection, Coliforms, Zinc, Lead.

The quality of rainwater from a tile and a galvanized-iron type roof catchment were analyzed over a period of 5 months. Examination of staggered 1 litre samples collected during a rainfall event showed that the concentrations of various pollutants were high in the first litre but decreased in subsequent samples with few exceptions. Faecal coliform and total coliform counts ranged from 8-13 (tile roof) and 4-8 (iron roof) to 41-75 (tile roof) and 25-63 (iron roof) colonies per 100 ml, respectively. However, no faecal coliforms were detected in the fourth and fifth litre samples from both roofs. The pH of rainwater collected from the open was acidic but increased slightly after falling on the roofs. The average zinc concentrations in the run-off from the galvanized-iron roof was about 5-fold higher compared to the tile roof, indicating leaching action but was well below the WHO limits for drinking water quality. Lead concentrations remained consistently high in all samples collected and exceeded the WHO guidelines by a factor of 3.5. For the roof area studied, a 'foul flush' volume of 5l. would be the minimum to safeguard against microbiological contamination but the high metals content in the water indicate the need for some form of treatment. Rainfall intensity and the number of dry days preceeding a rainfall event significantly affects the quality of run-off water from the catchment systems. (Author's abstract)
W90-00834

ECONOMIC IMPACT OF MICRO CATCHMENT DEVELOPMENT.

Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-00882

EVALUATION OF THE STREAMING CURRENT DETECTOR--I. USE IN JAR TESTS.

Delaware Univ., Newark. Dept. of Civil Engineering.
S. K. Dentel, A. V. Thomas, and K. M. Kingery.
Water Research WATRAG, Vol. 23, No. 4, p 413-421, April 1989. 9 fig, 2 tab, 19 ref.

Descriptors: *Instrumentation, *Water treatment, *Coagulation, *Alum, Streaming current detector, Laboratory equipment, Water treatment facilities.

The streaming current detector, or SCD, was evaluated as a means of characterizing coagulation performance in water treatment plants. Jar tests utilized buffered water, kaolinite suspensions, or suspensions containing kaolinite plus activated carbon. Alum dose and pH were controlled parameters. Electrophoretic mobility measured for suspensions as a function of pH or alum addition was found to be well correlated to SCD readings, though less significantly after alum dosages. An offset was also observed such that a negative SCD output corresponded with zero electrophoretic mobility. This was attributed to incomplete coverage of the negatively charged probe surfaces of the SCD. Salt additions decreased the magnitude of SCD readings as a result of double layer compression and weak adsorption. Alum doses which led to near-neutral SCD readings corresponded to conditions of decreased jar test turbidities, and the nature of the relationship suggests that dose control with an SCD is practicable. However, some experimental conditions were located where this was not the case. Carbon addition to kaolinite suspensions improved settleability and increased alum requirements at high pH, but did not affect the correlation between streaming current and supernatant turbidity. (See also W90-00902) (Author's abstract)
W90-00901

EVALUATION OF THE STREAMING CURRENT DETECTOR--II. CONTINUOUS FLOW TESTS.

Delaware Univ., Newark. Dept. of Civil Engineering.
S. K. Dentel, A. V. Thomas, and K. M. Kingery.
Water Research WATRAG, Vol. 23, No. 4, p 423-430, April 1989. 8 fig, 1 tab, 11 ref.

Descriptors: *Instrumentation, *Water treatment, *Coagulation, *Alum, *Process control, Streaming current detector, Water treatment facilities, Monitoring.

A streaming current detector (SCD) was used in continuous flow experiments to characterize its response to various conditions. Buffered water and kaolinite systems were coagulated with alum at various doses. The dose was incremented in a stepwise manner while monitoring SCD output, or alternated between samples with and without alum added. It was found that the SCD responded rapidly and reversibly to changes in sample characteristics over a wide range of coagulant concentrations. Readings were similar to those obtained from batch SCD measurements. However, when extremely high doses of alum or ferric chloride (2 mM as Al or Fe) were applied, the SCD signal became erratic. Extent and characteristics of this effect differed according to the coagulant used, delay time between the coagulant addition and SCD sampling, coagulant dose and whether or not an ultrasonic cleaning accessory was employed. Several different cleaning methods were found to alleviate the difficulties, but some cleaning agents themselves interfered with SCD output. (See also W90-00901) (Author's abstract)
W90-00902

AQUEOUS CHLORINATION OF PERMETHRIN.

Water Research Centre, Medmenham (England).
M. Fielding, and J. Haley.
Water Research WATRAG, Vol. 23, No. 4, p 523-524, April 1989. 1 fig, 1 tab, 3 ref.

Descriptors: *Water treatment, *Chlorination, *Permethrin, *Residual chlorine, *Disinfection, Water mains, Byproducts, Drinking water, Insecticides, Pesticides, Chemical reactions, Water conveyance.

Solutions of mixtures of cis and trans permethrin in alcohol are widely used for the removal of aqueous invertebrates, usually Asellus aquaticus, from water mains. During permethrin treatment, it has been customary practice not to maintain a chlorine residual because of the possibility of chlorine reacting with permethrin. Because of the interest in maintaining the disinfection residual while treating for infestation, permethrin containing water was chlorinated under conditions normally employed for disinfection. Cis and trans permethrin were shown not to react with chlorine under conditions likely to be found during water treatment disinfection even in the presence of bromide. Consequently, no products are likely to be formed should operators wish to maintain a chlorine residual while deinfesting mains water supply. (Peters-PTT)
W90-00914

DRINKING WATER STANDARDS AND RISK ASSESSMENT.

Environmental Protection Agency, Washington, DC. Office of Water Supply.
For primary bibliographic entry see Field 5G.
W90-00922

OPTIMIZATION OF WATER SUPPLY SYSTEMS: RISK ANALYSIS AND RELIABILITY OF SUPPLY.

R. P. Warren, S. C. Cook, J. P. Lumbers, and P.

Fanner.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 22-26, February 1989. 2 fig, 2 ref.

Descriptors: *Risk assessment, *Water conveyance, *Water supply, *Simulation analysis, Probabilistic process, Reservoir storage.

Probability analysis of network failures can be applied to the operation of water supply networks in the determination of minimum permissible reservoir storage to maintain required levels of service under optimized conditions. In the longer term, probability analysis could be used to assist the scheduling of routine maintenance. This would involve the identification and simulation of crises under a range of maintenance scenarios to determine, for given minimum reservoir storage, any worsening of reliability of supply as measured by the probabilities of failure. The preceding analysis results in one set of reservoir levels to match desired reliability of supply associated with given consumer demands and disposition of pumping plant. The analysis requires prior knowledge of operator response during each simulated failure. Were this response to vary significantly (under different plant maintenance schemes for example) a more sophisticated approach would be required. In this case, the possibility of using a knowledge-based system to simulate operator response would seem to have potential. (Author's abstract)
W90-00924

OPERATING EXPERIENCES AT LANGSETT WATER TREATMENT WORKS.
Yorkshire Water Authority (England). Southern Div.
P. J. Briens, D. K. Lyon, and R. Baggaley.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 50-59, February 1989. 2 fig, 8 tab, 1 ref.

Descriptors: *Water treatment facilities, *England, *Operating costs.

The New Treatment Works at Langsett, in the Pennine foothills of South Yorkshire, was commissioned by Yorkshire Water in July 1985 and has produced water within EC standards ever since. During the first year of operation the average output was 48 ML/day, 18 ML/day above the average from the old filter stations resulting in a savings of over L200.000/year. During the summer of 1987 raw water quality was the worst ever experienced with color up to 17.0 Abs/m (230 deg Hazen), well in excess of the quoted maximum of 12.4 Abs/m (165 deg Hazen). However, increasing the coagulant dosage resulted in final water remaining within EC standards. The two-stage clarification process followed by rapid gravity filtration has proved to be adaptable to changing water conditions. Modifications are now complete on the chemical dosing system, which should improve reliability of the process supporting machinery and reduce maintenance costs. The present cost of water from Langsett is L22.2/ML, being L10/ML above the cost of water from the old slow sand filters. (Rubinstein-PTT)
W90-00927

NEW ZEALAND RURAL WATER SUPPLY CONCEPT AND THE DEVELOPING WORLD.
B. A. Fairburn, and H. R. Wise.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 89-95. February 1989. 4 fig, 1 tab, 6 ref.

Descriptors: *Rural areas, *New Zealand, *Water supply development, *Technology transfer, Developing countries, Cost analysis.

The historical development of the New Zealand rural water supply concept is described, and the basic principles are explained in terms of both its design features and reliance upon community involvement during the promotional constructional and operational phases. Conceptional and cost comparisons are made between the New Zealand rural water supply concept and its urban counterpart, and an analysis is undertaken of the transferability of the concept to a developing world situation with the consequent emphasis on low-cost construction and self-help operation. The adoption of the New Zealand model is advocated as a potential design concept for a range of defined circumstances in developing countries. (Author's abstract)
W90-00931

5G. Water Quality Control

SIMPLE MODELS TO EVALUATE NONPOINT POLLUTION SOURCES AND CONTROLS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W90-00013

INTEGRATION OF RUNOFF AND RECEIVING WATER MODELS FOR COMPREHENSIVE WATERSHED SIMULATION AND ANALYSIS OF AGRICULTURAL MANAGEMENT ALTERNATIVES.
Anderson-Nichols and Co., Inc., Palo Alto, CA.
A. S. Donigian.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 265-275, 2 fig, 1 tab, 11 ref.

Descriptors: *Farm management, *Water pollution prevention, *Simulation analysis, *Hydrologic models, *Agricultural runoff, *Model studies, *Agricultural watersheds, Water quality control, Runoff, Management planning, Pollution load, Path of pollutants, Pesticides, Nutrients.

Mathematical models of agricultural runoff processes are being used to analyze and predict the quantity and quality of runoff from agricultural lands. The ultimate goal is to use these models to develop a Best Management Practice (BMP) plan that will maintain agricultural productivity while minimizing adverse water quality impacts. However, runoff models by themselves are not sufficient to predict water quality effects of BMP's since instream transport and transformations are not usually represented. Although agricultural runoff models can be used to evaluate a BMP's effects on runoff and pollutant loadings from small, field-sized areas, they must be linked with receiving water quality models to assess the quality in receiving waters resulting from BMP's applied to the watershed. Moreover, the runoff and receiving water quality models must be compatibly designed, so that the runoff and agricultural pollutant loadings (e.g., sediment, pesticides, nutrients) can be accepted, transported, and transformed by the associated aquatic processes in the receiving water model. Water quality conditions resulting from agricultural practices depend on both surface and subsurface pollutant loadings from fields, and instream processes affecting contaminant fate and transport. Consequently, the use of models to properly analyze this cause-effect relationship between water quality and agricultural practices must include both field scale runoff and receiving water models, and linkage or integration procedures. This paper describes the integration procedures used by the EPA Hydrologic Simulation Program-FORTRAN (HSPF) to link surface runoff, subsurface flow (and quality) and receiving water modules to perform comprehensive watershed simulation. The watershed segmentation process is discussed and various applications of HSPF are cited as examples of analyzing the water quality impacts of Agricultural Best Management Practices. (See also W90-00001) (Lantz-PTT)
W90-00014

MODELING SUBSURFACE DRAINAGE AND WATER MANAGEMENT SYSTEMS TO ALLEVIATE POTENTIAL WATER QUALITY PROBLEMS.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skuggs, and J. W. Gilliam.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 295-318, 10 fig, 3 tab, 55 ref.

Descriptors: *Subsurface drainage, *Water pollution control, *Nonpoint pollution sources, *Hydrologic models, *Groundwater movement, *Water quality management, *Drainage, *Path of pollutants, DRAINMOD, Computer models, Nitrates, Irrigation effects, Model studies, North Carolina, Water management, Trafficability.

A computer model for simulating the operation of drainage and water table control systems is described and applied to evaluate the effects of drainage system design and operation on nitrate outflow. The model, DRAINMOD, was developed for design and evaluation of multicomponent systems which may include facilities for subsurface drainage, surface drainage, subirrigation or controlled drainage and irrigation of wastewater onto land. The model is based on a water balance in the soil profile and is composed of a number of components, incorporated as subroutines, to evaluate the various mechanisms of water movement and storage in the profile. Several field studies to evaluate the reliability of the model were conducted. Experiments were conducted to test the model in North Carolina, Ohio, Louisiana, Florida and California with good results in each location. As an example of the application of the model to nonpoint source pollution problems, it was modified to predict nitrate movement from artificially drained soils with high water tables. The study resulted in the following conclusions for a Typic Umbraqualt soil under North Carolina climatic conditions: (1) trafficability and crop protection requirements of a drainage system can usually be satisfied by several drainage system designs and operational procedures; (2) nitrate outflows for lands with good surface drainage are considerably less than for poor surface drainage; (3) the amount of NO3-N that leaves the field through drainage waters can be reduced by using controlled drainage during the winter months and during the growing season. (See also W90-00001) (Lantz-PTT)
W90-00016

DISTRIBUTED PARAMETER HYDROLOGIC AND WATER QUALITY MODELING.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W90-00018

FIELD DATA ACQUISITION SYSTEMS.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W90-00021

EFFECTIVENESS OF LIMING TO MITIGATE LAKE-WATERSHED ACIDIFICATION.
Electric Power Research Inst., Palo Alto, CA. Environmental Science Dept.
J. E. Davis, and R. A. Goldstein.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 57-70, 5 fig, 26 ref.

Descriptors: *Lake restoration, *Water pollution control, *Acidification, *Acid rain, *Lime, *Model studies, Water pollution effects, Flushing, Calcium carbonate, Hydrogen ion concentration, Alkalinity, Aluminum, Fisheries, Land use, Watershed management.

The Integrated Lake-Watershed Acidification Study (ILWAS) model was modified to accept pulse inputs of calcium carbonate dry deposition on user specified dates and over selective areas of the Woods Lake watershed. Responses at the lake outlet and in several soil horizons in the catchment were simulated for various liming scenarios comparing separate applications to both lake and land surfaces and at two different dose levels over the land area. The direct lake application was charac-

terized by large, immediate, short duration increases in lake outlet pH and alkalinity, attributable to a sudden influx of alkaline material that quickly flushed through the aquatic system. The terrestrial application was characterized by lower magnitude, more gradual and longer duration increases in both lake outlet and soil pH and alkalinity, attributable to enhancement of the base saturation at soil cation exchange sites. Inorganic aluminum concentrations, a concern with respect to fishery health, were only temporarily reduced following the lake application, while dramatic reductions were sustained for several decades following the terrestrial applications; this suggests terrestrial liming slows the rate of chemical weathering and leaching of aluminum. These results suggest that for lakes having short retention times and streams, liming part or all of the land catchment might be advantageous to liming only the lake or stream as a means of mitigating lake acidity. This conclusion and the potential for concurrent mitigation of terrestrial effects employing land catchment liming requires experimental study. This study illustrates the utility of mechanistic computer models as a complementary tool to ongoing field studies in acidic deposition effects. (See also W90-00063) (Lantz-PTT)
W90-00065

SAVE THE RAIN.
Natural Resources Defense Council, Inc., New York.
D. A. Sheiman.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 81-85.

Descriptors: *Water pollution control, *Legislation, *Acid rain, *Air pollution control, *Sulfur dioxide, Nitrogen oxides, Regulations, Political aspects, State jurisdiction, Air pollution effects, Environmental effects, Environmental protection, Public opinion.

Acid rain is currently one of the most widespread environmental problems. Its effects are cumulative and may be irreversible. Almost monthly, authoritative scientists issue new warnings about the deleterious effects of acid rain. The cause is known--50 million tons of sulfur and nitrogen oxide pollution emitted each year in North America--and the cure known--pollution control. The technical means to solve the problem are in hand. But pollution reductions will require government action to stem the emissions of millions of tons of sulfur and nitrogen oxides that pollute the air, the water and the land. In 1986, the acid rain issue moved further on the political agenda than it ever has previously, providing cause for optimism that a control program is just a short way off. Several state governments, notably New Hampshire, Wisconsin and Minnesota, enacted state level emissions reductions programs. In addition, a breakthrough occurred on April 10, when a bipartisan coalition of 150 members of the House of Representatives introduced H.R. 4567, the Acid Deposition Control Act of 1986. By the end of the 99th Congress, the bill had gathered more than 170 cosponsors, a remarkable showing of support. Like all consensus legislation, H.R. 4567 is a compromise. Its emission reduction requirements will not achieve the 12 million ton reduction in sulfur dioxide emissions required to halve acid deposition, as recommended by the National Academy of Sciences in 1981. Its timetable, stretching out more than a decade, seems excessive considering the five years that states and utilities have already had to prepare for a control program. Further, the bill's emission limits for many types of motor vehicles simply codify EPA's current, weak standards. Despite these compromises, environmentalists supported H.R. 4567 as a politically viable measure that could begin to curtail the damage caused by acid deposition. Further legislation has been introduced because the public has pushed the legislature to recognize the seriousness of the acid rain problem. (See also W90-00063) (Lantz-PTT)
W90-00066

ACID DEPOSITION: RESEARCH, INFORMATION, POLICY: A COLLOQUIUM. THE ROLE OF RESEARCH IN POLICY DEVELOPMENT: AN INDUSTRIAL PERSPECTIVE.
For primary bibliographic entry see Field 5B.
W90-00067

FLORIDA ACID DEPOSITION RESEARCH PROGRAM.
Florida State Dept. of Environmental Regulation, Tallahassee. Bureau of Air Quality Management.
For primary bibliographic entry see Field 5C.
W90-00068

ACID DEPOSITION RESEARCH AND POLICY.
Kentucky Energy Cabinet, Lexington. Dept. for Energy Research and Development.
For primary bibliographic entry see Field 5B.
W90-00069

LEGISLATING A FAIR AND EFFECTIVE NATIONAL ACID DEPOSITION CONTROL PROGRAM: AN OHIO PERSPECTIVE.
Ohio Consumers' Counsel Governing Board, Columbus.
P. A. Centolella.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 285-292, 6 ref.

Descriptors: *Air pollution control, *Ohio, *Legislation, *Water pollution control, *Acid rain, Federal jurisdiction, Economic aspects, Costs, Coal mining, Regulations.

This paper presents an Ohio perspective on federal acid rain legislation. It conveys both Ohio's commitment to support fair and effective legislation and the state's concern that legislation be cost effective and include a significant cost sharing program. To be cost effective acid rain legislation should seek to minimize adverse rate impacts, avoid unnecessary economic dislocations in the coal industry, and effectively reduce the environmental costs of acid deposition. A significant national cost sharing program is urged for economic as well as equity reasons. The paper also reviews the probable costs of H.R. 4567 to Ohio and the shortcomings of that legislation from an Ohio perspective. (See also W90-00063) (Author's abstract)
W90-00071

ACID DEPOSITION PROGRAM: SCOPE OF WORK.
Virginia State Air Pollution Control Board, Richmond.
For primary bibliographic entry see Field 5B.
W90-00072

WISCONSIN ACID DEPOSITION PROGRAM.
Wisconsin Dept. of Natural Resources, Madison. Bureau of Air Management.
T. B. Sheffy.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 350-388, 14 fig, 3 tab, append.

Descriptors: *Air pollution control, *Acid rain, *Legislation, *Wisconsin, *Water pollution control, Electric power industry, Sulfates, Nitrogen oxides, Costs, Economic aspects, Research priorities.

Introduced at the request of the Governor, the acid rain legislation is based on the unanimous recommendations adopted by the Governor's Acid Deposition Review Committee. Major features of 1985 Senate Bill 546 are as follows: (1) emission limits for major electric utilities; (2) an annual target of 250,000 tons of SO2 from the major utilities is effective January 1, 1993; (3) an annual statewide target of 75,000 tons SO2 applies to existing large industrial and municipal utility sources, effective January 1, 1993; (4) an annual statewide target of 325,000 tons of SO2 applies to major utilities and other large sources, effective January 1, 1993; (5) a nitrogen oxide (NOx) target of 135,000 tons of annual emissions to be applied to major utilities on January 1, 1991; (6) cost-effective; (7) minimal electric rate increases to consumers; (8) allows for further research; (9) protects vital segments of Wisconsin's economy by safeguarding the environment; and (10) has no impact on new industrial growth. (See also W90-00063) (Lantz-PTT)
W90-00073

WHAT WE KNOW/WHAT WE DID/WHY/WHAT WE WILL DO (ABOUT ACID RAIN).
Ontario Ministry of the Environment, Toronto.
W. Scott.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 423-465, 2 fig, 118 ref.

Descriptors: *Air pollution control, *Ontario, *Acid rain, *Regulations, *Water pollution control, Air pollution, Acid rain effects, Sulfates.

Ontario has been in the forefront of the acid rain issue and acid rain research in North America. In 19773, the Ontario Ministry of the Environment, in cooperation with the Ontario Ministry of Natural Resources initiated the Sudbury Environmental Study to define the nature and extent of the damage and to develop criteria for the management of atmospheric emissions from the Sudbury mining/smelting industries. Studies were conducted, and results are reported on, for three areas: atmospheric processes, aquatic effects, and terrestrial effects. The results from these studies led to Ontario's new package of emission controls, which will impact the four major corporate sources of SO2 emissions in the province: Ontario Hydro, INCO, Falconbridge Ltd., and Algoma Steel-Wawa. An examination of the predicted effects the reduction of Ontario emissions by 67% by the new Ontario control program clearly shows the importance of the Ontario emission reductions. However, at many of the monitored receptor sites, deposition levels will still be well above the target level of 20 kg of wet sulfate/ha/yr, even after all the Canadian emission controls are in place. Even if Canadian SO2 emissions were cut to zero, the target level could not be reached. The target level of 20 kg/ha/yr is designed to protect all but the most sensitive aquatic systems from the effects of acid rain. If the United States take significant action, this target could be reached. (See also W90-00063) (Lantz-PTT)
W90-00075

ACID PRECIPITATION ISSUE: HAVE WE LOST SIGHT OF PAST LESSONS.
Quebec Ministere de l'Environnement, Sainte-Foy.
L. Lapointe.
IN: Acid Rain 1986: A Handbook for States and Provinces. Proceedings of Wingspread Conference, September 23-25, 1986. The Acid Rain Foundation, Inc., St. Paul, MN, 1986. p 468-498, 9 fig, 4 tab.

Descriptors: *Air pollution control, *Acid rain, *Water pollution control, *Regulations, *Quebec, Sulfur dioxide, Nitrogen oxides, Copper, Industrial wastes.

In eastern North America, attention has been mainly focused on reducing sulfur dioxide (SO2) because of its significant contribution to acid deposition. Nitrogen oxides (NOx) constitute the second most important source. If a control program is aimed at protecting aquatic ecosystems, reduction of SO2 emissions is the logical target. On the other hand, where damages to forests are concerned, efforts should focus on reducing nitrogen oxides emissions (NOx) because of their contribution to acidic deposition and photochemical reactions which produce ozone, a known toxic to plant. Moreover, it is acknowledged that reductions in SO2 and NOx emissions would be helpful in abating effects on human health, aquatic and forest ecosystems, materials, historic buildings and monuments, and visibility. In February 1985, the

government of Quebec adopted a regulation which guaranteed the gains acquired between 1980 and 1984 while allowing for additional decreases of at least 45% from 1980 emissions. These decreases will mostly be attained through a 50% emission reduction from the Noranda Mines copper smelter in Noranda, by far the biggest source of SO2 emissions in Quebec. At the end of 1985, Ontario also adopted a regulation providing for a reduction in SO2 emissions to 885 kilotons in 1994 compared to 2.2 million tons in 1980, a reduction equal to 60%. By these actions, the Canadian provinces and federal government wished to make their true preoccupation with the acid precipitation problem and their political will to take the necessary steps towards it resolution, while encouraging their neighbors south of the border to do the same. They are convinced that the same initiatives by other North American governments constitute the decisive factor in the battle against acid rain. (See also W90-00063) (Lantz-PTT)
W90-00076

DRINKING WATER CRITERIA DOCUMENT FOR POLYCHLORINATED BIPHENYLS (PCBS): 1987 REVIEW OF THE DRAFT FINAL.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-105845. Price codes: A03 in paper copy, A01 in microfiche. March 9, 1988. 10p, 3 ref.

Descriptors: *Water quality control, *Drinking water, *Polychlorinated biphenyls, *Regulations, Organic compounds, Toxicity.

The Halogenated Organics Subcommittee of the Science Advisory Board's Environmental Health Committee completed its independent scientific review of the Draft Drinking Water Criteria Document for polychlorinated biphenyls (PCBs). The review was conducted in Washington, DC. November 19-20, 1987. The major recommendation of the Subcommittee was that the Environmental Protection Agency explore whether the available data on PCB congeners can be developed on a scale of toxicity similar to the toxicity equivalency factor that the Agency had already prepared for dioxins. This effort could potentially yield some scientifically interesting insights relating to uncertainties in the PCB data base even if it represents only an approximation in which data analysis and scientific judgment are combined. In general the Subcommittee concluded that the document suffers from a failure to clearly identify its scientific objectives. (Author's abstract)
W90-00085

EPA: GROUND WATER HANDBOOK.
Robert S. Kerr Environmental Research Lab., Ada, OK.
Government Institutes, Inc., January 1989. 212p, 139 fig, 30 tab, 347 ref, append.

Descriptors: *Handbooks, *Administrative agencies, *Water pollution control, *Groundwater management, *Groundwater pollution, Groundwater movement, Groundwater recharge, Research priorities, Management planning, Regulations.

The subsurface environment of groundwater is characterized by a complex interplay of physical, geochemical, and biological forces that govern the release, transport and fate of a variety of chemical substances. The impact of natural groundwater recharge and discharge processes on distributions of chemical constituents is understood for only a few types of chemical species. Since so many climatic, demographic and geohydrologic factors may vary from place to place, or even small areas within specific sites, there can be no single 'standard' approach for assessing and protecting the quality of groundwater that will be applicable in all cases. Despite these uncertainties, investigations are under way and they are used as a basis for making decisions about the need for, and usefulness of, alternative corrective and preventive actions. One purpose of this document is to discuss measures that can be taken to ensure that uncertainties do not undermine the ability to make reliable predictions about the response of contamination to various corrective or preventive measures. An important part of EPA's groundwater research program is to transmit research information to decision makers, field managers and the scientific community. This publication has been developed to assist that effort and, additionally, to help satisfy an immediate Agency need to promote the transfer of technology that is applicable to groundwater contamination control and prevention. The need exists for a resource document that brings together available technical information in a form convenient for groundwater personnel within EPA and state and local governments on whom EPA ultimately depends for proper groundwater management. The information contained in this handbook is intended to meet that need. (Lantz-PTT)
W90-00087

REVIEW OF THE SELENIUM HEALTH CRITERIA DOCUMENT.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-109029. Price codes: A02 in paper copy, A01 in microfiche. Report No. SAB-EHC-88-036, July 19, 1988. 4p.

Descriptors: *Reviews, *Selenium, *Public health, *Water quality control, Drinking water, Heavy metals.

The Metals Subcommittee of the Science Advisory Board's Environmental Health Committee has completed its review of the Drinking Water Health Criteria Document for Selenium dated December 1986. The review was conducted January 14-15, 1988 at the St. James Hotel in Washington, DC. The Subcommittee made two recommendations--that more information was needed in the document on the studies on which the standard is based and that the Drinking Water Equivalent Level (DWEL) should be 200 micrograms/L based on an uncertainty factor of 10. The Committee observed that the EPA for its suggested drinking water equivalent level has chosen a factor 15 and concludes that the safe range of daily selenium intake is 50 to 200 micrograms. The Subcommittee further recommended that because previous studies and the National Academy of Sciences recommendation plays such an important role in the development of the drinking water equivalent level, that detail be more defined in these studies. (Lantz-PTT)
W90-00090

SITE CHARACTERIZATION: TECHNICAL APPROACHES TO RCRA COMPLIANCE.
Battelle Pacific Northwest Labs., Richland, WA. Site Characterization and Assessment Section.
R. M. Smith, and R. Schalla.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011895. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA--15872, April 1988. 11p, 2 fig. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Waste disposal, *Regulations, *Resources Conservation and Recovery Act, *Water pollution, Groundwater quality, Monitoring, Data acquisition.

The basic premise of this report is that the Resource Conservation and Recovery Act compliance for site characterization and groundwater monitoring is subject to technical interpretation resulting in a negotiated compliance between the responsible party and the regulatory agency. The degree to which the responsible party can exercise technical license in designing a groundwater monitoring system varies between components of the system. However, the responsible party must convince the regulatory agency that the data collected truly represent the groundwater system and that the approach taken is technically sound. While much progress has been made toward developing tools and strategies for adequately characterizing disposal sites, additional developments are needed in both monitoring hardware and interpretive techniques. (Lantz-PTT)
W90-00091

DEVELOPMENT DOCUMENT FOR FINAL EFFLUENT GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE ORE MINING AND DRESSING POINT SOURCE CATEGORY: GOLD PLACER MINE SUBCATEGORY.
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117790. Price codes: A10 in paper copy, A01 in microfiche. Final Report, May 1988. 276p, 61 fig, 97 tab, 56 ref.

Descriptors: *Mine wastes, *Water pollution control, *Standards, *Gold, *Mine drainage, Alaska, Regulations, Economic aspects, Wastewater treatment, Water pollution control.

The Clean Water Act (CWA) designates various levels of technology as the basis for effluent limitations: best practicable technology (BPT), best available technology economically achievable (BAT), best conventional pollutant control technology (BCT), and best available demonstrated technology (BDT). Effluent limitations guidelines based on the application of BPT, BAT, and BCT are to be achieved by existing sources. To gather the technical and economic information necessary to promulgate a regulation, an extensive sampling and analysis effort was undertaken during the 1983, 1984, 1985, and 1986 mining seasons. As part of this effort, 69 placer mines were visited by EPA. Sampling was conducted at all 69 of these mines, and treatability testing of wastewater was performed on 63 of them. A total of 106 treatability tests were performed, including 477 simple settling and 59 chemically assisted settling tests. Many mining operations, including those visited in these investigations, provided economic and technical operating information. During the 1986 mining season there were over 450 active commercial gold placer mines in the United States. The number of operations including recreational and assessment mines could be in excess of 1,000. Approximately 42% of these commercial mines are located in Alaska. Promulgation of this regulation is expected to have greatest impact on the industry in Alaska, as substantial water discharge regulations are in place for the gold placer mines in the lower 48 states. (Lantz-PTT)
W90-00096

INTAKE STRUCTURE OPERATION STUDY, LOST CREEK DAM, OREGON.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Div.
For primary bibliographic entry see Field 8A.
W90-00099

IMPACTS OF A PROPOSED COAL MINE IN THE FLATHEAD RIVER BASIN.
International Joint Commission-United States and Canada, Washington, DC.
For primary bibliographic entry see Field 4C.
W90-00128

SOME BASIC INFORMATION FOR THE MANAGEMENT OF URBAN LAKES NEAR PERTH, WESTERN AUSTRALIA.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
B. A. Carbon, G. A. Bartle, and A. M. Murray.
Technical Memorandum 88/16, December 1988. 29p, 12 fig, 6 tab, 4 ref.

Descriptors: *Urban areas, *Lake restoration, *Lakes, *Water management, *Australia, Perth, Water level, Surface-groundwater relations, Lake evaporation, Lake sediments, Seasonal variation, Nutrients, Organic matter.

The levels of water in the shallow, freshwater lakes, and their contiguous groundwaters, fell by 4 to 5 mm each day in the nearly rainless period

from November to April (summer), but were recharged during the wet winter and spring. In summer there was an increase in concentration of inert chloride ion in the lake water compared to the groundwater. This indicated that lake waters evaporated faster, and that there was a net water flow from groundwaters to lakes. In winter this was reversed. Mineral concentrations, and orthophosphate concentrations, were higher in lakes than in groundwaters. During parts of summer, when phosphate in groundwater was 0.1 parts per million (ppm), lake water concentrations rose from 1 ppm to 5-10 ppm, reflecting a release of nutrients from the lake bed. The lakes had a distinct, peaty lake bed. These beds were usually several meters thick and consisted mainly of organic matter with diatomaceous earth. They contained high concentrations of nutrients, with up to 15,000 ppm of total nitrogen and 700 ppm of total phosphorus. The concentration of nitrogen and phosphorus in lake water seemed to be dependent on short-term sorption of nutrients from the lake bed, which in turn varied with pH and other factors. The transient concentration of nutrients in lake waters gave little indication of the nutrient reserves of the lake water-lake bed system. The water levels in lakes could be artificially maintained up to 1 m above the surrounding groundwater, provided water was introduced from an external source at a rate of 10-30 millimeter/day. (Author's abstract)
W90-00130

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME I.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5A.
W90-00132

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME II.
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 7C.
W90-00133

DETERMINATION AND ENHANCEMENT OF ANAEROBIC DEHALOGENATION: DEGRADATION OF CHLORINATED ORGANICS IN AQUEOUS SYSTEMS.
Battelle Columbus Div., OH. Cellular and Molecular Biology Section.
For primary bibliographic entry see Field 5D.
W90-00134

FIELD GUIDE TO THE APPLICATION OF DISPERSANTS TO OIL SPILLS.
CONCAWE, The Hague (Netherlands).
A. Gillot, G. H. R. Aston, P. Bananzinga, Y. le Gal la Salle, and M. J. Mason.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-115984. Price codes: E04 in paper copy, A01 in microfiche. Report No. 2/88, March 1988. 64p, 19 fig, 9 tab, 29 ref, 4 append.

Descriptors: *Handbooks, *Cleanup operations, *Dispersants, *Oil spills, *Water pollution treatment, Oil pollution, Weathering, Safety, Economic aspects, Regulations.

Choosing the most appropriate method to apply dispersant on to an oil spill is essential if the most effective use of dispersants is to be achieved. The objective of this field guide is to describe techniques presently available for applying dispersants, so that the reader is in a better position to decide on the system of application to ensure best effect. The most effective dispersants currently available are high efficiency concentrates, developed for undiluted application (i.e. without any mixing with seawater). Dispersant should be applied as moderately coarse droplets, with diameters in the range 500-1000 micrometers (um), whether application is by surface vessel, aircraft or land-based equipment. The use of dispersants is one of the few major options available for responding to a spill. However, it is important to recognize the limitations of dispersants, in particular their inability to treat highly weathered viscous oils and water-in-oil emulsions. Each means of application at sea has its benefits. Small vessels may be easily deployed inshore, whereas larger vessels and equipment can be deployed in nearby offshore areas for long periods. All aircraft offer a very rapid response according to their range and payload, while large aircraft with their relatively high rate of coverage are particularly suited to large spills. Although aircraft operating costs are high, aerial spraying is often cost-effective when compared with the cost of the consequences of not carrying out timely treatment. Oil spill dispersants are skin degreasing chemical formulations and, whenever handling or spraying is being carried out, personal protective equipment should be worn. Spraying equipment should be regularly maintained and dispersants carefully stored. A regular check on the efficiency of stored dispersants should be carried out. As with all emergency response activities, a well defined plan should be maintained and training exercises regularly conducted. (Lantz-PTT)
W90-00140

GROUND-WATER MONITORING COMPLIANCE PROJECTS FOR HANFORD SITE FACILITIES.
Battelle Pacific Northwest Labs., Richland, WA.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-010687. Price codes: A04 in paper copy, A01 in microfiche. Progress Report for the Period October 1 to December 31, 1987. Report No. PNL--6536, February 1988. 92p, 15 fig, 12 tab, 13 ref, append. DOE Contract DE-AC06-76RLO-1830.

Descriptors: *Groundwater pollution, *Observation wells, *Monitoring wells, *Radioactive wastes, *Waste disposal, Monitoring, Hazardous wastes, Aquifers, Groundwater quality, Landfills, Water quality control, Hydrologic data collections.

This report documents the progress of four Hanford Site groundwater monitoring projects for the period from October 1 to December 31, 1987. The four disposal facilities are the 300 Area Process Trenches, 183-H Solar Evaporation Basins, 200 Areas Low-Level Burial Grounds, and Nonradioactive Dangerous Waste (NRDW) Landfill. This report is the sixth in a series of periodic status reports; the first five cover the period from May 1, 1986 to September 30, 1987. This report satisfies the requirements of Section 17B(3) of the Consent Agreement and Compliance Order issued by the Washington State Department of Ecology (1986b) to the US Department of Energy-Richland Operations Office. During this reporting period, field activities consisted of completing repairs on two monitoring wells around the 183-H Basins and completing construction of the last 10 of 35 monitoring wells around the 200 Areas Burial Grounds. These wells were completed by November 30, 1987, in compliance with the above-referenced Compliance Order. Pretest hazardous chemical analyses of groundwater samples and aquifer tests were conducted in the 200 Area wells where possible. The data are presented in this report. Analytical results for the 300 Area, 183-H, and the NRDW Landfill indicate no deviations from the established trends reported in previous progress reports. (Lantz-PTT)
W90-00153

BLUEPRINT FOR THE ENVIRONMENT: A PLAN FOR FEDERAL ACTION.
Howe Brothers, Salt Lake City. 1989. 335p. Edited by T. Allan Comp.

Descriptors: *Environmental policy, *Political aspects, *Environmental protection, *Management planning, Federal jurisdiction, Water pollution prevention, Standards, Governmental interrelations.

Before the floods and fires and droughts and pollution of the summer of 1988, America's environmental leaders met to develop a new approach to their environmental concerns. It was to be nonpartisan in its development and focused on the President and the offices that make up the Executive branch of government. It was to cover every aspect of environmental concern--it was to be a Blueprint for the Environment. When finally presented to President-elect Bush on November 30, 1988, the Blueprint was over 1500 pages in length, containing nearly 730 individual recommendations for needed federal action within the environment. Each of the original Blueprint recommendations, contained on a single sheet of paper, is directed to a specific assistant secretary or administrator within a specific cabinet office. The front side contains the particular office to which the recommendations is directed, a brief recommendation statement and several paragraphs of explanatory text. The back side contains the budget saving or expenditure that results from this specific recommendation, both the House and Senate committees and subcommittees involved with the particular issue and relevant studies on the topic. It also lists other related federal programs, some of the best sources of expertise from among the Blueprint participants, and, on occasion, specific implementation steps and a budget history of the office or program involved. Each federal department, from Agriculture to Treasury, is preceded by a short summary text to acquaint the reader with the largest issues facing that particular department and some of its history as well. Most of the original Blueprint recommendations are reproduced here. A total of 511 approaches to national environmental problems each one a reasoned solution for a specific concern best addressed by the federal government. Blueprint for the Environment has become a checklist for responsible federal action, a guide to the complex workings of the government and a clear indication of the impact of federal environmental action--or inaction. (Lantz-PTT)
W90-00161

EVALUATION OF MILITARY FIELD-WATER QUALITY. VOLUME 4. HEALTH CRITERIA AND RECOMMENDATIONS FOR STANDARDS. PART 1: CHEMICALS AND PROPERTIES OF MILITARY CONCERN ASSOCIATED WITH NATURAL AND ANTHROPOGENIC SOURCES.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-013813. Price codes: A10 in paper copy, A01 in microfiche. Report No. UCRL--21008-Vol. 4-Pt. 1, February 1988. 265p. Edited by Jeffrey I. Daniels. Department of the Army Project 82PP2817.

Descriptors: *Water quality standards, *Water quality control, *Public health, *Drinking water, Field tests, Turbidity, Color, Dissolved solids, Chlorides, Magnesium, Sulfates, Arsenic, Cyanide, Pesticides, Biodegradation, Organic compounds.

The recommended standards for drinking water for field water constituents and properties of military concern, are applicable only to military personnel deployed in the field and they are meant to protect against performance-degrading effects resulting from the ingestion of field water. Standards are recommended that address both short-term (< 7 days) and long-term < 1 yr but > 7 days) field water consumption at rates of 5 and 15 L/day. Turbidity and color are the physical properties of concern because they can adversely impact the organoleptic quality (e.g., taste, odor, or appearance) of field water and thereby lead to reduced water consumption and subsequent involuntary dehydration, which can degrade performance. Total dissolved solids, chloride, magnesium, sulfate, inorganic arsenic, cyanide, the pesticide lindane, and metabolites of aquatic algae and associated bacteria (i.e., geosmin and 2-methylisoborneol) are the chemical constituents of concern because they can be responsible for degrading performance directly as a consequence of their toxic properties and/or indirectly by adversely affecting the organoleptic quality of field water, which can result in reduced water consumption and an increased risk of dehydration. (See W90-00164 thru W90-00173) (Author's abstract)
W90-00163

TURBIDITY AND COLOR.

California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
A. W. Olivieri, R. C. Cooper, and R. E. Danielson.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 11-44, 5 fig, 5 tab, 27 ref, 2 append.

Descriptors: *Water quality control, *Turbidity, *Color, *Drinking water, Odors, Standards, Microorganisms, Disinfection, Chlorination, Food habits, Attitudes, Aesthetics, Organoleptic properties, Food habits, Attitudes, Aesthetics, Organoleptic properties.

Data is presented that relate the percent of military personnel that would drink water with varying levels of turbidity, color, and odor. The data suggest that approximately a third of military personnel might reject field water that meets existing military standards (5 units of turbidity and 50 units of color). However, a turbidity level < or = to 1 nephelometric-turbidity unit (NTU) not only would tend to improve the efficacy of disinfection for most infectious microorganisms (the protozoa Giardia and Cryptosporidium are notable exceptions), but also would reduce the percentage of military personnel that may refuse to drink the water and become susceptible to the performance degrading effects of dehydration to levels as low as 2%, if the color and odor are absent. It is recommended that the existing turbidity standard of 5 units be changed to 1 NTU, and that the existing color standard be changed to 15 color units for long-term (< 1 yr) exposure and 50 color units for short-term (< 6 d) exposure because: (1) color is not directly associated with health effects; and (2) these color levels, although noticeable, can be considered tolerable for military populations from an organoleptic or aesthetic standpoint. (See also W90-00163) (Lantz-PTT)
W90-00164

TOTAL DISSOLVED SOLIDS.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
J. I. Daniels, and D. W. Layton.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 45-61, 2 fig, 4 tab, 22 ref.

Descriptors: *Water quality control, *Dissolved solids, *Drinking water, Taste, Standards, Public health, Food habits, Attitudes.

After assessing health effects literature, it can be concluded that high total dissolved solids (TDS) concentrations are not clearly linked with specific health effects; however, high TDS concentrations in water will make the taste of the water objectionable to many individuals, causing them to reject it. In some situations, these individuals could become susceptible to dehydration, which could lead to performance degrading effects. One methodology from the literature is used to estimate the proportion of field personnel that would refuse to drink water based on TDS content. Recommendations were then developed for TDS standards for military field water supplies based on this computational procedure. According to the calculations, consideration should be given to lowering the present military field water quality standard for TDS from 1500 mg/L to 1000 mg/L. This reduction would reduce the percentage of the military population that might refuse to drink the water from approximately 7% for a 1500 mg/L TDS standard to about 2% for the 1000 mg/L TDS standard. Additionally, the 2% figure probably could be lowered even more if proper water consumption discipline were enforced. A 1000 mg/L TDS standard should also minimize an increase in laxative effects from elevated TDS among the military population consuming the water and possibly accelerate the adaptation process for those individuals accustomed to the taste of water with lower TDS. (See also W90-00163) (Lantz-PTT)
W90-00165

CHLORIDE.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
J. I. Daniels, and D. W. Layton.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 62-81, 2 fig, 4 tab, 27 ref.

Descriptors: *Water quality control, *Chlorides, *Drinking water, Public health, Reverse osmosis, Field tests, Water quality, Standards, Attitudes, Food habits.

This chapter recommends drinking water standards for the chloride anion (Cl(-)) in military field water supplies. The relationship between health effects and chloride concentrations in drinking water supplies is poorly documented. However, the available evidence suggests that chloride will give water an objectionable taste for many individuals at concentrations well below those that cause laxative effects. Consequently, individuals that refuse to drink such poor-tasting water are susceptible to dehydration in situations where large sweat losses must be replaced by increased water intake. Because chloride is a constituent of the total dissolved solids (TDS) content of water (particularly field water that has been processed through a reverse osmosis water purification unit (ROWPU), and because both TDS and chloride cause an objectionable taste, the chloride concentration is converted to a TDS content for the water. Then the proportion of the military population that will refuse to drink water is estimated quantitatively, based on the TDS concentration. Using this computational procedures, chloride standards for military field water supplies are recommended; the present field water quality standard for chloride, 600 mg/L for both short-term (7 day) and long-term (1 yr) exposure periods, could be retained because only about 2% of the military population will refuse to drink such water. (See also W90-00163) (Lantz-PTT)
W90-00166

MAGNESIUM.
California Univ., Davis. Dept. of Environmental Toxicology.
R. Scofield, and D. P. H. Hsieh.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 82-98, 2 tab, 47 ref.

Descriptors: *Magnesium, *Water quality control, *Drinking water, Public health, Potable water, Water quality, Water quality standards.

The objective of this chapter is to develop and recommend a drinking water standard for the magnesium ion (Mg(2+)). High levels of Mg in water are of concern because they can produce diarrhea and thereby disrupt the normal water balance of military personnel, particularly in hot climates. A no-effects concentration was determined by estimating a single no-effect dose and calculating the concentration that would result if the dose were diluted into the volume of water suggested. Thus, the recommended standard for Mg(2+) is 30 mg/L for a water consumption rate of 15 L/d, and 100 mg/L for a water consumption rate of 5 L/d. (See also W90-00163) (Author's abstract)
W90-00167

SULFATE.
California Univ., Davis. Dept. of Environmental Toxicology.
R. Scofield, and D. P. H. Hsieh.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 99-119, 5 tab, 41 ref.

Descriptors: *Sulfates, *Drinking water, *Water quality control, Potable water, Standards, Public health.

The purpose of this chapter is to develop and recommend a drinking water standard for sulfate (SO4(2-)) in military field water supplies. High levels of sulfate are of concern because they can produce diarrhea and thereby disrupt the normal water balance of soldiers, particularly in hot climates. A no-effects concentration was determined by estimating a single no-effect dose and calculating the concentration that would result if the dose were diluted into the volume of water suggested to be consumed daily by military personnel. Thus, the recommended standard for SO4(2-) is 100 mg/L for a water consumption rate of 15 L/d, and 300 mg/L for a water consumption rate of 5 L/d. (See also W90-00163) (Author's abstract)
W90-00168

ARSENIC.
California Univ., Davis. Dept. of Environmental Toxicology.
R. Scofield, and D. P. H. Hsieh.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 120-152, 4 tab, 94 ref.

Descriptors: *Water quality control, *Arsenic, *Drinking water, Potable water, Water quality, Standards.

The purpose of this chapter is to develop criteria and recommend military drinking water standards for inorganic arsenic. The recommended standards are intended to prevent performance degradation or irreversible effects in troops who will be exposed to water that contains arsenic for up to 7 d or up to 1 yr. Based on human no-effect levels, 7-d and 1-yr standards are calculated assuming both a 15 L/d and a 5 L/d water consumption rate. Uncertainties and assumptions in the standards are identified and explained to allow maximum flexibility in administration. For an assumed daily water consumption of 15 L, the recommended standards are 100 micrograms/L for a period up to 7 d and 20 micrograms/L for a period up to 1 yr. For an assumed daily water consumption of 5 L, the recommended standards are 300 micrograms/L for a period up to 7 d and 60 micrograms/L for a period up to 1 yr. (See also W90-00163) (Author's abstract)
W90-00169

CYANIDE.
California Univ., Davis. Dept. of Environmental Toxicology.
R. Scofield, D. W. Layton, G. DeNike, K. Heckman, and D. P. H. Hsieh.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 153-197, 1 fig, 4 tab, 138 ref.

Descriptors: *Cyanide, *Drinking water, *Water quality control, Potable water, Standards, Water quality, Public health, Model studies, Pharmacokinetics.

The objective of this chapter is to develop criteria and recommend military standards for cyanide in drinking water. These standards are intended to prevent performance degradation or irreversible effects in troops exposed for periods of up to either 7 d or 1 yr to water that contains cyanide. The recommended standards are calculated with a one-compartment pharmacokinetic model and are based on the assumption that 0.5 mg/L is the maximum tolerable concentration of cyanide in whole blood. For an assumed water consumption

rate of 15 L/d, the recommended standard is 2 mg/L for a 5 L/d consumption rate, the recommended standard is 6 mg/L. (See also W90-00163) (Author's abstract)
W90-00170

LINDANE.
California Univ., Davis. Dept. of Environmental Toxicology.
R. Scofield, A. Raha, J. Kelly-Reif, and D. Hsieh.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 198-237, 9 tab, 115 ref.

Descriptors: *Lindane, *Water quality control, *Drinking water, Standards, Public health, Potable water, Organic compounds.

In this chapter, drinking water standards for lindane are developed and recommended. The recommended standards are intended to prevent performance degrading or irreversible effects in troops who will be exposed to lindane-containing water for up to either 7 d or 1 yr. The 7 d and 1 yr standards are calculated assuming both 15 L/d and 5 L/d water consumption rates. Uncertainties and assumptions associated with the recommended standards are identified and explained to allow maximum flexibility in administration. For an assumed daily rate of water consumption of 15 L, the recommended standard is 0.2 mg/L for an exposure period up to either 7 d or 1 yr. For an assumed daily rate of water consumption of 5 L, the recommended standard is 0.6 mg/L for an exposure period up to either 7 d or 1 yr. (See also W90-00163) (Author's abstract)
W90-00171

ALGAE AND ASSOCIATED AQUATIC BACTERIA.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
M. A. Nelson, and J. I. Daniels.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 238-253, 2 tab, 46 ref.

Descriptors: *Aquatic bacteria, *Algae, *Water quality control, *Drinking water, Microorganisms, Potable water, Biodegradation, Taste, Odors, Biochemistry.

Algae and associated aquatic microorganisms are commonly found in fresh and marine waters. Many of these microorganisms have been identified as the source of taste and odor (organoleptic) problems in surface waters, particularly drinking water reservoirs. Two of these microorganisms, cyanobacteria (blue-green algae) and actinomycetes (Gram-positive filamentous bacteria that grow in close association with cyanobacteria), are important from the perspective of military field water quality because they can release the compounds geosmin and 2-methylisoborneol (MIB), into water. These substances are persistent and can cause taste and odor problems at extremely low concentrations. Furthermore, cyanobacteria are the source of other biochemicals (i.e., alkaloid, lipopolysaccharide, and polypeptide compounds) that are considered to be toxic to animals and therefore to man. In this chapter, the potential impact field water containing these biochemicals can have on the performance of military personnel if they consume such water, is discussed. Field water quality standards are recommended for the taste-causing and odor-causing biochemicals,geosmin and MIB, because data are sufficient to support such recommendations. (See also W90-00163) (Author's abstract)
W90-00172

RESEARCH RECOMMENDATIONS.
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
D. W. Layton, and J. I. Daniels.
IN: Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources. Report No. UCRL--21008-Vol.4-Pt. 1, February 1988. p 254-261, 7 ref.

Descriptors: *Research priorities, *Water quality control, Standards, Public health, Toxicity, Turbidity, Disinfection, Magnesium, Sulfates, Chlorides, Arsenic, Bacteria, Lindane, Water quality.

The field water quality standards recommended for adoption by the Armed Forces of the United States were developed in the face of limited and sometimes discordant data. Research necessary to reduce important sources of uncertainty or to strengthen the scientific basis of the recommended standards is described. This research should include human studies with military personnel under field conditions so that the relationship between the organoleptic properties of water and the desire to consume such water is made more clear. Also, toxicological and pharmacological studies employing suitable animal models should be performed to explain the mechanisms of action of the more toxic substances such as arsenic, and cyanide. Finally, future research should examine the synergistic effects that combinations of constituents in field water can have on military performance. Among the most important research studies recommended are those addressing: (1) the relationship between turbidity and disinfection; (2) the effects of magnesium and sulfate with respect to the organoleptic and laxative properties of total dissolved solids; (3) the precise implications of chloride with respect to operation of reverse osmosis water purification units; (4) the nature of the human health effects associated with different chemical species of arsenic; (5) the importance of excretion pathways, such as sweating, with regard to cyanide detoxification and elimination; (6) the dose-response relationship for lindane with regard to subtle neurological changes and military performance; and (7) the consequences of ingesting water containing concentrations of toxins released by cyanobacteria. (See also W90-00163) (Author's abstract)
W90-00173

OIL SPILL RECOVERY: OIL BOOMS AND SKIMMERS, JANUARY, 1971-OCTOBER, 1988: CITATIONS FROM THE U.S. PATENT BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-870258, Price codes: N01 in paper copy, N01 in microfiche. October 1988. 46p.

Descriptors: *Patents, *Oil spills, *Bibliographies, *Cleanup operations, *Oil recovery, Oil skimmers, Dispersants, Microbial degradation, Beaches, Ultrasonics.

This bibliography contains 127 citations of selected patents concerning booms, skimmers, and skimming techniques for oil spill recovery. Selected patents include oil absorbent materials, dispersants, floating booms, methods and equipment for oil spill containment and collection, marine barriers, cryogenic beach cleaners, microbial materials, and ultrasonic oil removal. Citations concerning oil-water separation for non-oil spill recovery applications are excluded and examined in a separate bibliography. (Author's abstract)
W90-00183

SUPERFUND RECORD OF DECISION (EPA REGION 2) LOVE CANAL, NIAGARA FALLS, NEW YORK, OCTOBER 1987. SECOND REMEDIAL ACTION.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117428. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/055, October 1987. 76p, 2 fig, 5 tab.

Descriptors: *Remedial action, *Water pollution treatment, *Superfund, *Love Canal, *Water pollution sources, *Cleanup operations, New York, Waste disposal, Dioxin, Sediments, Costs, Leachates.

The Love Canal site is located in the southeast corner of the city of Niagara Falls and is approximately one-quarter mile north of the Niagara River. The canal was one of two initial excavations designed to provide inexpensive hydroelectric power for industrial development around the turn of the 20th century. Hooker Chemicals and Plastics Corporation (Hooker), now Occidental Chemical Corporation, disposed of over 21,000 tons of chemical wastes, including dioxin tainted trichlorophenols, into Love Canal between 1942 and 1953. In the mid to late 1970s, continued periods of high precipitation contributed to water accumulation in the disposal area causing chemically-contaminated leachate to be carried to the surface and into contact with residential basement foundations. Also, dioxin and other contaminants migrated from Love Canal to the sewers which have outfalls to nearby creeks. The remedial program at Love Canal has been extensive and occurred in two phases. Phase one consisted of measures aimed at site containment. Phase two is directed at remediating contaminated drainage tracts. Approximately 30,400 cu yd-40,900 cu yd of creek and sewer sediments are contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin, commonly referred to as dioxin. The selected remedial action for this site includes: construction of an onsite dewatering/containment facility (DCF) to include a separate construction/demolition debris facility (CDF); onsite containment of sewer and creek sediments in the DCF prior to thermal destruction in a transportable thermal destruction unit; onsite storage in the DCF of leachate treatment residuals and other material generated as a result of remediation; onsite storage of uncontaminated debris in the CDF; onsite disposal of non-hazardous thermal treatment residuals to avoid disturbance of the existing cap; and scaling down of the DCF to only include the construction/demolition debris material. The estimated present worth cost for this remedial action ranges from $26,400,000 to $31,400,000. (Author's abstract)
W90-00235

GROUNDWATER RESTORATION FIELD TEST AT THE HOE CREEK UNDERGROUND COAL GASIFICATION SITE.
University of Wyoming Research Corp., Laramie. Western Research Inst.
J. S. Nordin, W. Barrash, and B. T. Nolan.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008735. Price codes: A03 in paper copy, A01 in microfiche. Report No. DOE/MC/11076--2454, February 1988. 30p, 5 fig, 8 tab, 11 ref. DOE Contract DE-FC21-86MC11076.

Descriptors: *Water pollution treatment, *Water quality control, *Coal gasification, *Groundwater pollution, *Groundwater management, Injection wells, Phenols, Field tests.

Two million gallons of groundwater were pumped from wells adjacent to the Hoe Creek II underground coal gasification cavity, passed through filters and carbon adsorbers, and reinjected into the cavity. Phenol was the target compound of the water treatment system. The phenol concentration in groundwater pumped from well WS-10 decreased from 974 parts per billion (ppb) when treatment began on July 2, 1987, to about 200 ppb when treatment ceased on August 29, 1987. Phenol concentrations in groundwater pumped from well WS-22 fluctuated during the tests, but they decreased to the 150 to 200 ppb of treated water reinjected into the Hoe Creek II cavity was below detectable limits (< 20 ppb). Pumping rates were about 18 gallons per minute (gpm) from well WS-110 and 6 to 7 gpm from well WS-22. Hoe Creek is located approximately 20 miles southwest of Gillette, WY. (Author's abstract)
W90-00245

TECHNICAL AND ECONOMIC DATA DEVELOPMENT CONCERNING THE LUST PROGRAM.
Eastern Research Group, Inc., Arlington, MA.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-012308. Price codes: A04 in paper copy, A01 in microfiche. Report No. DOE/PE/16037--T3, February 1987. 67p, 1 fig, 28 tab.

Descriptors: *Model studies, *Economic aspects, *Fuel, *Underground storage, *Water pollution prevention, *Water quality control, *Gasoline, *Leakage, Waste disposal, Waste management, Underground waste disposal, Oil industry, Water pollution sources, Model studies.

The US EPA is developing a regulatory program to prevent groundwater contamination due to leaking underground storage tanks (LUST). These tanks are used by all gasoline service stations and by a number of other energy-related industries. New regulations under the EPA LUST program are expected to allow installation of only corrosion-resistant tanks (e.g., fiberglass tanks) and to require replacement of some existing steel tanks. This report describes the EPA program and presents technical, economic, and financial background information on the energy industries likely to be affected. This information will be used in future studies to examine the economic impact of the LUST regulations. A review of data on existing underground storage tanks was performed to identify the energy industries likely to be impacted by the LUST regulations. Gasoline service stations, accounting for 800,000 of the 2.3 million underground tanks in place, is the primary affected industry. Petroleum refineries with large tank farms and utility companies with underground tanks for their vehicle fleets may also be impacted by the LUST requirements. Although not an energy industry, the trucking industry also was selected for detailed analysis because of the prevalence of underground tanks in the industry and its importance to energy delivery and other vital economic activities. For the four industries of interest (gasoline service stations, petroleum refineries, utilities, and trucking establishments), industry profiles and prepared and representative or 'model' facilities were defined. The industry profiles described the size, activities, and economic condition of the industry. Model facilities within each industry were defined to represent typical storage tank characteristics (including the age, number, size, and corrosion-related characteristics of underground tanks) and typical economic/financial conditions (including income statements, balance sheets, and financial ratios). The model facilities as defined here can be used in later studies to analyze the economic impact of the LUST program as the regulations are issued. (Lantz-PTT)
W90-00249

EVALUATION OF PROPOSED DREDGED MATERIAL DISPOSAL ALTERNATIVES FOR NEW YORK/NEW JERSEY HARBOR, PHASE I.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W90-00251

LIMING PROJECT HAERSKOGEN 1976-1986: WATER CHEMICAL AND BIOLOGIC RESPONSE ON LIMING IN SEVEN WEST SWEDISH LAKES (KALKNINGSPROJEKTET HARSKOGEN 1976-1986: VATTENKEMISK OCH BILOGISK RESPONS PA KALKNINGSATGARDER I SJU VASTSVENSKA SJOAR).
Swedish Environmental Research Inst., Stockholm.
I. Alenaes.
Available from National Technical Information Service, Springfield, VA 22161 as DE88-752910/GAR. Price codes: A04 in paper copy, A01 in microfiche. December 1986. 60p, 25 fig, 7 tab, 14 ref. English summary.

Descriptors: *Acid rain, *Sweden, *Lime, *Lakes, *Lake restoration, *Acidic water, Limestone, Aquatic life, Fish, Invertebrates.

This report describes a liming project where 2000 tons of limestone were spread in seven lakes on the Swedish west coast. Six different limestone products and six different application techniques were tested. The overall results are very positive, though acid surges were documented. 50-95% of the applied limestone was dissolved during 1977-85. Fish reproduction improved and benthic invertebrates showed long-term expansion within and between lakes; valuable knowledge to be used in future designing of biological applied liming strategies was obtained. (Author's abstract)
W90-00270

CURRENT APPROACHES TO DEVELOPING SEDIMENT QUALITY CRITERIA.
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5A.
W90-00311

CHARMED LIFE OF A LAKE CALLED PRAIRIE ROSE.
C. E. Little.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 6, p 459-461.

Descriptors: *Agricultural runoff, *Iowa, *Sedimentation, *Lake restoration, *Terracing, *Soil erosion, Environmental policy, Slope stabilization, Lakes, Dredging.

The federal Rural Clean Water Program has been instrumental in saving Iowa's Prairie Rose Lake. By the end of the 1970s, rowcrop farming of the steep hills surrounding the lake was causing 26,000 tons of sediment to be deposited into the lake annually. In 1980 the lake was dredged and the following year 37 of the area's 44 farmers agreed to implement a water quality plan. Through techniques such as stripcropping, conservation tillage, sedimentation traps and terracing, soil loss has been reduced from 20 tons per acre to 5 tons per acre. The sedimentation rate has been cut by two-thirds. According to the 1987 Prairie Rose Lake project report by the Rural Clean Water Program, the project area now has 51 miles of terracing. The cost of saving the lake and surrounding farm land, to date, has totaled half a million dollars. (Mertz-PTT)
W90-00327

BENEFITS AND COSTS OF AGRICULTURAL NONPOINT-SOURCE POLLUTION CONTROLS: THE CASE OF ST. ALBANS BAY.
Economic Research Service, Washington, DC. Commodity Economics Div.
C. E. Young, and J. S. Shortle.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 1, p 64-67, January-February 1989. 5 tab, 8 ref.

Descriptors: *Nonpoint pollution sources, *Economic evaluation, *Agricultural runoff, *Cost-benefit analysis, *Vermont, *Water pollution control, St Albans Bay, Lake Champlain, Cost sharing, Dairy industry, Wastewater treatment.

Benefits of a combined program to control agricultural runoff and upgrade municipal wastewater treatment in the St. Albans Bay watershed of Lake Champlain in Vermont are estimated to exceed costs by $1.7 million for the period 1981-2030. Control of runoff from dairy farms in the watershed may increase net farm income due to cost-share payments and more efficient use of manure nutrients. Appreciation in property values and enhanced recreational experiences were the primary water quality benefits. Insufficient information is available to isolate the marginal benefits attributable to the individual control efforts and to determine optimal levels of water quality improvements. (Author's abstract)
W90-00330

EFFECTS OF ANIMAL WASTE CONTROL PRACTICES ON NONPOINT-SOURCE PHOSPHORUS LOADING IN THE WEST BRANCH OF THE DELAWARE RIVER WATERSHED.
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
M. P. Brown, P. Longabucco, M. R. Rafferty, P. D. Robillard, and M. F. Walter.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 1, p 67-70, January-February 1989. 2 fig, 11 ref. USEPA Agreement CR 806839.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Phosphorus, *Delaware River, *New York, *Animal wastes, Water pollution effects, Cannonsville Reservoir, Dairy industry, Agricultural watersheds, Manure.

The water quality objective of the New York Sate Model Implementation Program was to reduce phosphorus (P) loading to the Cannonsville Reservoir, a eutrophic impoundment on the West Branch of the Delaware River that supplies drinking water to New York City. The Model Implementation Program focused on controlling P losses from animal waste sources in the rural watershed, particularly dairy barnyards. Results indicated that runoff from the West Branch watershed during the winter-spring period accounted for more than 80% of the annual loading of dissolved and total P to the reservoir. Reductions in barnyard P losses of 50% to 90% were shown to be achievable using practices that reduced the volume of runoff from these areas. However, the contribution of P from barnyard runoff was substantially less than that from manure-spread cropland in the budget for annual losses of dissolved and total P in the West Branch watershed. Manure spreading schedules that guide the location and timing of spreading had the potential to reduce P loading from the studied subwatershed by as much as 35% in the absence of short-term or long-term manure storage systems. Because treatment of cropland was given only limited attention by the Model Implementation Program, P loading reduction attributable to the program as well as the response of the reservoir's water quality were negligible. (Author's abstract)
W90-00331

GEOLOGY AND SURVIVAL ON THE SNAKE RIVER PLAIN.
C. E. Little.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 2, p 127-129, March-April 1989.

Descriptors: *Soil conservation, *Soil erosion, *Idaho, *Agricultural watersheds, *Irrigation effects, *Trout, Environmental policy, Agricultural runoff, Snake River Plain, Rock Creek, Suspended sediments.

Rock Creek, a 40-mile long tributary that drains into the Snake River in Idaho was selected for reclamation by the Rural Clean Water Project. A century of farming had reduced the creek to murky waters devoid of it's once-famous trout. According to a survey by the Agricultural Research Service, 75% of all of the fields in the area had lost topsoil, with 33% of the fields exhibiting white soils. This white soil layer consisted of calcium carbonate and was known to lie about one foot under the topsoil of the farm fields. Through a 75% cost-sharing program farmers installed new irrigation systems meant to reduce sediment runoff from their fields. These changes resulted in sediment reductions of about 55%, allowing Rock Creek to begin clearing and trout to return. A second strategy suggested by the Rural Clean Water Program was to encourage farmers to adopt conservation tillage, as well as reduce the use of fertilizers and pesticides. Only about 10% of the farmers have converted to conservation tillage at this time. (Mertz-PTT)
W90-00335

PARTICLE TRAVEL TIMES OF CONTAMINANTS INCORPORATED INTO A PLANNING MODEL FOR GROUNDWATER PLUME CAPTURE.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 5B.
W90-00356

EVALUATION OF THE FACTORS DETERMINING THE EFFECTIVENESS OF WATER QUALITY BUFFER ZONES.
Dept. of Geography and Planning, East Carolina University, Greenville, NC 27858.
J. D. Phillips.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 133-145, March 30 1989. 2 fig, 3 tab, 29 ref.

Descriptors: *Buffer zones, *Water quality control, *Model studies, *Soil water, *Hydrologic properties, *Overland flow, Hydraulic properties, Darcys law, Suspended load, Water quality, Surface runoff.

The relative role of slope length, slope gradient, surface roughness, and soil hydrologic properties are examined in determining the pollution control effectiveness of vegetated buffer zones. Two models describing buffer conveyance capacity are introduced. The first assumes that pollutant transport through the buffer depends on the energy of overland flow and is based on Bagnolds' stream power concept. The second assumes that buffer effectiveness is a function of total contact time of both surface runoff and throughflow and is based on Darcy's law and the Manning equation. The hydraulic and detention models, respectively, are applied to the problem of estuarine shoreline buffer zone delineation in Carteret County, North Carolina. Results show that where solid-phase pollutants transported as suspended or bedload in overland flow are the major concern, slope gradient is the most critical factor, followed by soil hydraulic conductivity. Where dissolved pollutants that are transported by both surface and subsurface flow are of concern, buffer width is by far the most important factor, with soil moisture storage capacity also playing a role. Methods developed here may be applied to any water quality buffer delineation problem to determine the relative influence of soil properties, geomorphology, and surface conditions. (Author's abstract)
W90-00359

ENGINEERING SOLUTION TO THE NITRATE PROBLEM OF A BOREHOLE AT SWAFFHAM, NORFOLK, U.K.
Birmingham Univ. (England). Dept. of Geological Sciences.
K. M. Hiscock, J. W. Lloyd, D. N. Lerner, and M. A. Carey.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 267-281, March 30 1989. 6 fig, 3 tab, 16 ref.

Descriptors: *Nitrates, *Groundwater pollution, *Geohydrology, *Boreholes, *Hydraulic structures, *Water quality control, Aquifers, Water chemistry, Test wells, Pump wells.

A possible solution to reduce nitrate concentrations in pumped groundwater is to case-out the section of the aquifer with a high nitrate content. This approach is best suited to a hydrogeological scenario where permeability and hydrochemistry are layered. A Chalk borehole at Swaffham, Norfolk was chosen and the upper layer cased-out. A considerable reduction in the concentrations of nitrate and other major ions was achieved immediately after completion of the engineering work, for example, nitrate and potassium concentrations were reduced by 50% and 58%, respectively. A 2 yr pumping test was designed to examine the long-term success of the technique and demonstrated that pumped groundwater nitrate values gradually increased as water with a high nitrate concentration leaked from the upper aquifer layer. After hydraulic equilibrium was reached, the rate of increase in nitrate concentration reduced considerably. A water quality model, incorporating a mixing cell calculation, was used to simulate the pumping test results. A good simulation of the observed nitrate concentrations was achieved when the process of molecular diffusion was included in the model. Predictions for the next five years suggest that the nitrate concentration will not increase above 13.6 mg N/l. The main disadvantage of the engineering solution is the significant loss in borehole yield experienced after casing-out the more permeable upper aquifer layer. (Author's abstract)
W90-00366

STUDY ON THE DEGRADATION OF N-ALKANES IN NO. 20 DIESEL OIL BY NATURAL STRAINS OF MICROORGANISMS FROM THE BOHAI SEA, (IN CHINESE).
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
For primary bibliographic entry see Field 5B.
W90-00372

POLYCYCLIC AROMATIC HYDROCARBON DEGRADATION BY A MYCOBACTERIUM SP. IN MICROCOSMS CONTAINING SEDIMENT AND WATER FROM A PRISTINE ECOSYSTEM.
National Center for Toxicological Research, Jefferson, AR.
For primary bibliographic entry see Field 5B.
W90-00393

IN SITU BIOREMEDIATION OF AN UNDERGROUND DIESEL FUEL SPILL: A CASE HISTORY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. T. Frankenberger, K. D. Emerson, and D. W. Turner.
Environmental Management EMNGDC, Vol. 13, No. 3, p 325-332, May-June 1989. 3 fig, 2 tab, 19 ref.

Descriptors: *Water pollution treatment, *Biodegradation, *Oil pollution, *Oil spills, *Fuel, *Diesel fuel, *Bioremediation, Case studies, Remedies, Storage tanks.

In the winter months of 1983, approximately 1000 gallons of diesel fuel had flowed along an asphalt parking lot of a commercial establishment towards a surface drain near an open creek. Investigations led to the discovery of an underground storage tank leaking diesel fuel. Exploratory borings showed that contamination was near the surface horizon and the capillary zone of the water table. Hydrocarbon quantities ranged up to 1500 mg/kg of soil. The plume continued to move in an eastward direction toward the surface water fo the creek. A laboratory study indicated relatively high numbers of hydrocarbon-oxidizing organisms relative to glucose-utilizing microorganisms in the unsaturated vadose zone. Bioreclamation was initiated in April 1984 by injecting nutrients (nitrogen and phosphorous) and hydrogen peroxide and terminated in October 1984 upon no detection (< 1 mg/kg) of hydrocarbons. A verification boring within the vicinity of the contaminated plume confirmed that residual contamination had attained background levels. The monitoring program was terminated in January 1987. (Author's abstract)
W90-00456

BIOKINETIC CONSTANTS OF A MIXED MICROBIAL CULTURE WITH MODEL DIESEL FUEL.
Sybron Chemicals, Inc., Salem, VA.
C. D. Goldsmith, and R. K. Balderson.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 145-154, Spring 1989. 3 fig, 3 tab, 12 ref.

Descriptors: *Water pollution treatment, *Biodegradation, *Wastewater treatment, *Culturing techniques, *Fuel, *Microbial degradation, *Diesel fuel, Biokinetic constants, Pseudomonas, Arthrobacter, Mixed cultures.

The aerobic biokinetic constants for a mixed culture utilizing diesel fuel as a substrate are investigated. Bacterial strains capable of degrading diesel fuel were obtained by enrichment culturing. These were identified as Pseudomonas alcaligenes, Pseudomonas aeruginosa and Arthrobacter crystallopoietes. Several substrate concentrations were monitored for utilization using 500 ml gas sampling bulbs containing minimal medium. These gas tight, batch vessels were used to determine biodegradation in a closed, aqueous system. The fuel was readily degraded with a maximum utilization rate of 0.75/hour. The maximum growth rate was 0.55/hour. The half saturation constant, Ks, was determined to be 81.22 mg/L. The cell yield was found to be 0.73 mg/L biomass as suspended solids produced per mg/L substrate as COD. Growth of each of four bacterial isolates on BTX, n-dodecane, 1-tridecane, naphthalene and anthracene in minimal medium was investigated. The least substrate specificity was shown by Arthrobacter crystallopoietes and Pseudomonas putida. Naphthalene was the most readily degraded by all isolates. (Author's abstract)
W90-00463

SUPPLEMENTAL CARBON USE BY MICROORGANISMS DEGRADING TOXIC ORGANIC COMPOUNDS AND THE CONCEPT OF SPECIFIC TOXICITY.
Alaska Univ., Fairbanks. Water Research Center.
For primary bibliographic entry see Field 5D.
W90-00466

BIOLOGICAL DEGRADATION OF XENOBIOTICS IN WASTE MANAGEMENT.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
K. Visscher, and J. Brinkman.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 6, No. 2, p 201-212, Spring 1989. 3 fig, 3 tab, 16 ref.

Descriptors: *Water pollution treatment, *The Netherlands, *Wastewater treatment, *Biological wastewater treatment, *Degradation, *Biodegradation, *Waste management, *Hazardous materials, Xenobiotics.

The application of biological processes in controlling environmental problems has increased strongly during the past decade. A characteristic and important aspect of biological processes is the feature that pollutants are degraded into products which are part of natural cycles. The generation of more fundamental knowledge on microbiological degradation offers the possibility of broadening the field of application, especially for degrading non-easily biodegradable pollutants. This creates the opportunity of developing biological methods for the treatment of hazardous and toxic wastes. So far, research in this field in the Netherlands has resulted in some important applications, such as treatment processes for industrial wastewater and processes for the cleaning of contaminated soil and the purification of polluted air. However, more research is necessary with the emphasis on the development of new technologies in order to apply present and future microbiological knowledge to specific environmental problems. The Dutch government supports this type of environmentally, and often economically, relevant research. (Author's abstract)
W90-00467

ONSITE BIOLOGICAL TREATMENT OF INDUSTRIAL LANDFILL LEACHATE: MICROBIOLOGICAL AND ENGINEERING CONSIDERATIONS.
DETOX, Inc., Dayton, OH.
For primary bibliographic entry see Field 5D.
W90-00468

PREDATION AND INHIBITORS IN LAKE WATER AFFECT THE SUCCESS OF INOCULATION TO ENHANCE BIODEGRADATION OF ORGANIC CHEMICALS.
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W90-00539

SCIENTIFIC BASIS FOR ECOLOGICAL STANDARDS GOVERNING ANTHROPOGENIC EFFECTS ON THE MARINE ECOSYSTEMS AS EXEMPLIFIED BY THE BALTIC SEA.
Obshchesoyuznyi Gosudarstvennyi Komitet SSSR po Gidrometeorologii i Kontrolyu Prirodnoii Stredii, Moscow.
For primary bibliographic entry see Field 5B.
W90-00548

GUIDELINES FOR SELENIUM IN IRRIGATION WATERS.
California Univ., Riverside.
N. Albasel, P. F. Pratt, and D. W. Westcot.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 253-258, Jul-Sep 1989. 1 fig, 57 ref.

Descriptors: *Selenium, *Agricultural runoff, *California, *Water reuse, *Alfalfa, Adsorption, Salinity, Leaching, Accumulation, Irrigation, Standards, San Joaquin Valley.

Due to the relatively high concentration of Se in the agricultural drainage waters of the west side of the San Joaquin Valley in California and the potential for reuse of these waters on salt tolerant crops, a reassessment of quality criteria for Se in irrigation waters for this area was needed. The specific conditions for this area that justified a reassessment were: (1) the Se in the drainage waters of the West Side is largely in the selenate (SeO4) form which is not appreciably adsorbed by soils and is thus readily leached from the root zone, (2) the waters containing high concentrations of Se have substantial concentrations of sulfate (SO4) that dramatically reduce SeO4 adsorption by plants, (3) the salinity of the waters that contain high Se concentrations demand leaching fractions (LF) that insure that Se is also leached from the root zone, and (4) kinetics of Se-species transformations. Recent research with alfalfa (Medicago sativa L.), which is one of the most sensitive for Se accumulations, suggests that this crop can tolerate an average soil solution Se concentration of 250 microg/L without exceeding the limit of 4 mg Se/kg in the dry weight of forage that has been set to protect bovine animals from Se toxicity. Based on a model the Se in the irrigation water can increase 100 microg/L at leaching fractions of 0.2 to 0.3 without exceeding the maximum established for this crop when irrigated with sulfate waters. Thus, the recommended maximum Se for alfalfa grown on the West Side of the valley is 100 microg/ L. Guidelines for other crops can be established if the relationships among the different sources of Se leaching factors, the Se in harvested products, and the maximum Se for various uses of products for protection of wildlife, domestic animals, and humans are known. (Author's abstract)
W90-00563

GUIDELINES FOR MOLYBDENUM IN IRRIGATION WATERS.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
N. Albasel, and P. F. Pratt.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 259-264, Jul-Sep 1989. 1 fig, 79 ref.

Descriptors: *Molybdenum, *California, *Agricultural runoff, *Irrigation water, Absorption, Salinity, Leaching, Crops, Tolerance, San Joaquin Valley.

Molybdenum (Mo) in relatively high concentrations has been found in saline SO4(2-) dominated agricultural drainage waters of the West Side of the San Joaquin Valley of California. Because of the potential for using these waters for irrigating salt-tolerant crops, an assessment of quality guidelines for Mo for the specific conditions of the this area was justified. The unique conditions of: (1) alkaline soils favoring Mo mobility, (2) the high leaching fractions required to control salinity in the root zone, and (3) the effect of SO4(2-) in reducing Mo absorption by plants suggested that the guideline of 10 microg/L to protect crops and animals be increased to 50 microg/L for the West Side of the San Joaquin Valley. The Mo input at this concentration, assuming the use of 10,000 cu m of water/ha, will be 0.5 kg/h. (Author's abstract)
W90-00564

PUMPING ALKALINE GROUNDWATER TO RESTORE A PUT-AND-TAKE TROUT FISHERY IN A STREAM ACIDIFIED BY ATMOSPHERIC DEPOSITION.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 8I.
W90-00618

QUALITY OF THE GROUND WATER AROUND THE LOWER REACHES OF THE MIYA RIVER.
National Research Inst. of Aquaculture, Mie (Japan).
For primary bibliographic entry see Field 2F.
W90-00649

BIOTRANSFORMATION OF AROMATICS IN STRIP-PIT POND.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W90-00657

HYDRAULIC CONDUCTIVITY OF THREE LANDFILL CLAY LINERS.
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5E.
W90-00666

SOCIAL CHOICE, RISK AND DETERMINATION IN WATER QUALITY MANAGEMENT.
Canberra Coll. of Advanced Education, Belconnen (Australia). School of Applied Science.
For primary bibliographic entry see Field 6A.
W90-00695

EFFECT OF LOW WATER LEVELS ON THE WATER QUALITY OF LAKE BIWA.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W90-00698

MARINE POLLUTION LEGISLATION IN CHINA: RETROSPECT AND PROSPECT.
Institute of Marine Environmental Protection, Dalian (China).
F. Zhijie.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 7, p 333-335, July 1989. 3 ref.

Descriptors: *Water law, *Marine environment, *Water pollution, *Legislation, *China, History, Reviews.

A general review of the historical development of legislation on matters relating to marine pollution in China is presented. Three historical periods may be defined in the development of legislation concerned with the protection of coastal waters in China. These are termed the early period (to 1965), the formative period (1966 to 1976), and the period of emergence (1977 to present). The years up to 1965 were characterized by a general lack of public attention to problems relating to coastal pollution per se in China. The decade from 1966 to 1976 was a time of great change in coastal pollution in China. The Cultural Revolution gave rise to massive expansion of coastal industries, with little or no regard for their effects upon the environment. In the period from 1977 to the present, two historic events had great impacts upon environmental protection in China. The first of these occurred in 1978, when the Constitution of the People's Republic of China was passed by the Fifth National People's Congress. The second historic event concerned with marine pollution was the passing of the Marine Environmental Law by the National People's Congress in 1982. These laws are suggested to provide a sound basis for reversing the previous trend of deteriorating coastal water quality, and for ensuring adequate protection of marine resources in the future. However, additional detailed regulations are necessary to strengthen the existing Marine Environment Law, and the successful implementation of the present laws remains as the greatest task. (Miller-PTT)
W90-00743

TREATMENT OF LANDFILL LEACHATE WITH AN UPFLOW ANAEROBIC REACTOR COMBINING A SLUDGE BED AND A FILTER.
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
J. Chang.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 133-143, July 18 1989. 8 fig, 4 tab, 9 ref. Nat. Sci. Council of the Rep. of China Grant NSC 75-0410-E006-03.

Descriptors: *Sludge bed, *Water pollution treatment, *Wastewater treatment, *Leachates, *Landfills, *Sludge filters, *Anaerobic digestion, Sludge, Contact beds, Organic wastes, Anaerobic conditions, Suspended solids, Leaching, Biological wastewater treatment.

The operational characteristics, efficiency of treatment of landfill leachate, and recovery of energy in a laboratory scale hybrid bioreactor were investigated. The reactor was a continuous upflow system combining a sludge bed and a filter and was operated at 35 C. This modified anaerobic sludge bed filter (SBF) reactor was found to provide efficient treatment of the organic constituents of the leachate. Removal of soluble COD was greater than 92% at organic loading rates less than 13 kg COD/cu m/d, and removal decreased to 70% with an organic loading rate of 21.77 kg COD/cu m/d. A solids balance indicated that 0.041 g volatile suspended solids (VSS) were produced per gram of COD removed. The removal of sulfate and soluble Fe was as high as 90% of 96.9%, respectively. An accumulation of Fe was observed. When the influent concentration of total Fe ranged from 160 to 515 mg/o, the total Fe concentration in the sludge was as high as 7,100 mg/l after a 185 day period of operation. The sulfate loading of the system affected energy recovery. When the sulfate loading rate increased from 102 to 683 mg/l/d, energy recovery decreased from 90% to 52%. The biogas conversion factor for methane was 0.31 at STP per gram of COD removed. (Author's abstract)
W90-00758

CHARACTERIZATION, DIGESTIBILITY AND ANAEROBIC TREATMENT OF LEACHATES FROM OLD AND YOUNG LANDFILLS.
Santiago Univ. (Spain). Dept. of Chemical Engineering.
R. Mendez, J. M. Lema, R. Blazquez, M. Pan, and C. Forjan.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 145-155, July 18 1989. 5 fig, 7 tab, 13 ref. Spanish CAICYT Contract PR 84-0466.

Descriptors: *Water pollution treatment, *Leachates, *Landfills, *Wastewater treatment, *Anaerobic digestion, *Sludge digestion, Wastewater, Comparison studies, Organic wastes, Sludge, Suspended load, Filtration.

A comparative study was conducted of the characteristics and susceptibility to treatment of leachates from two landfill sites differing in age, i.e., the length of time for which they have been operated. The study included evaluation of the utility of applying anaerobic digestion treatment to the leachates from the landfill sites receiving solid urban refuse from populations of similar standards of living. The leachates from the older tip have much lower levels of organic load, 40% of which was refractory to the anaerobic digestion treatment applied. The digestibility of leachates was studied by using a semicontinuous suspended sludge system. It was possible to remove up to 65% of the soluble COD of leachates from the young tip by means of an anaerobic filter working at HRTs less than 2 days. This system proved to be highly stable when its operating conditions were subjected to perturbations similar to those likely to be suffered by a full-scale plant. Results of the study showed that digestion of leachates from landfill sites that have been operated for many years is ineffective because a large fraction of the polluting substances is nonbiodegradable. Other treatment methods are accordingly preferable for this kind of leachate. Leachates from 'young' tips can be profitably subjected to anaerobic digestion, since although they, too, contain a refractory fraction, their COD is greatly reduced to levels similar to those of old-tip leachates. The anaerobic filter tested achieves this reduction with short retention times and its efficiency is stable under a variety of perturbations. (Friedmann-PTT)

W90-00759

RAPID BIOLOGICAL CLEAN-UP OF SOILS CONTAMINATED WITH LUBRICATING OIL.
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and N. M. Johnson.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 209-219, July 18 1989. 4 fig, 4 tab, 30 ref.

Descriptors: *Biological treatment, *Water pollution treatment, *Soil contamination, *Cleanup operations, *Oil pollution, *Lubricants, *Leachates, *Biodegradation, *Microbial degradation, Microorganisms, Oil spills, Degradation, Dispersants.

An experimental program was conducted to assess which mechanisms control the rapid biodegradation of used lubricating oil that contaminates soils. The ultimate goal is to effect a rapid biodegradation before the contaminants in the oil are leached into the groundwater or carried into surface waters with runoff. Large amounts of lubricating-oil-degrading bacteria could be grown in liquid culture, as long as a dispersant was applied to form and maintain an oil-in-water emulsion. Application of the oil-degrading bacteria (up to 4.9 times 10 to the 8th/g soil) significantly increased the initial rate of oil degradation in soil plots. However, the long-term rate of degradation slowed as the more available or more biodegradable components of the oil were removed. The fastest removal rates were obtained when the oil-contaminated soil was put into a water-soil slurry and was inoculated with microorganisms and dispersant. Improved microorganism contact and dispersant effectiveness apparently were responsible for the rapid rates in slurry reactors. The increased rates demonstrated the potential value of adding a large, acclimated inoculum and providing good mixing and dispersion to make the oil more available to the microorganisms. (Author's abstract)
W90-00765

DIVERSION PROJECT ALLEVIATES SALT-WATER INTRUSION.
Dames and Moore, San Francisco, CA.
G. D. Dearth.
Public Works PUWOAH, Vol. 120, No. 9, p 82-83, August 1989.

Descriptors: *Water pollution control, *California, *Saline water intrusion, *Diversion structures, Construction, Structural models, Groundwater depletion, Diversion channels, Hydraulic models.

California's Oxnard Plain is one of the state's most productive agricultural areas. The demand for irrigation and municipal water has put severe stress on the upper groundwater basin underlying the plain. Pumping from water supply wells has lowered groundwater levels, causing seawater to intrude into the basin over an area exceeding 22 sq miles. It was decided that a permanent facility was needed to stabilize the river bed at the point of diversion, and to divert larger quantities of water with reduced maintenance costs. To develop the hydraulic design concept for the diversion structure, canal inlet, and sediment-flushing channel, a hydraulic modeling study was conducted. A scale model of the project was built and tested for the expected range of flows and operating conditions. Due to funding constraints, the construction of the project is being undertaken in two phases. The first construction phase was marked by the completion of a trapezoidal, concrete-lined diversion canal. Constructing the gravity diversion dam using roller-compacted concrete is the main feature of the second, more difficult phase. Roller-compacted concrete was selected for the diversion structure because it allows rapid construction. The excavation, dewatering, and placement of the concrete can be completed in one construction season, which is essential in a river where the flow rate commonly fluctuates by as much as four orders of magnitude between summer and winter. (White-Reimer-PTT)
W90-00798

DEVELOPMENT AND APPLICATION OF A MODEL FOR REGIONAL WATER QUALITY MANAGEMENT.
Minho Univ., Braga (Portugal). Dept. of Civil Engineering.
J. M. P. Vieira, and L. Luklema.
Water Research WATRAG, Vol 23, No. 6, p 767-777, June 1989. 8 fig, 4 tab, 16 ref.

Descriptors: *Water quality management, *Regional planning, *Mathematical models, Water treatment, Wastewater treatment, Portugal.

A mathematical model has been developed for determining the optimal extent of regional water and wastewater treatment and wastewater diversion schemes in a river basin. Systems optimization was applied to minimize the overall cost of those schemes, taking into consideration the stream assimilative capacity and the prescribed levels of the surface water quality parameters. The model was tested in a real situation, determining the minimum cost, size and optimal location of the treatment scheme to be built in the River Ave basin in Portugal. (Author's abstract)
W90-00835

ANALYSIS OF NONEQUILIBRIUM DESORPTION OF VOLATILE ORGANICS DURING FIELD TEST OF AQUIFER DECONTAMINATION.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
J. M. Bahr.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 3, p 205-222, August 1989. 13 fig, 1 tab, 10 ref.

Descriptors: *Water pollution treatment, *Aquifer testing, *Landfills, *Groundwater pollution, *Environmental tracers, *Hydrologic models, Injection wells, Flow characteristics, Aquifer characteristics, Test wells, Pump wells, Flow velocity, Flow measurement, Model studies, Organic compounds, Dimensional analysis, Solute transport, Sorption, Canada.

A two-well injection-withdrawal experiment was conducted at a hazardous waste disposal site near Ottawa, Canada to assess the feasibility of aquifer restoration by means of a purge well network. The six-day test involved injecting tracer-labeled clean water into one well while withdrawing contaminated water from a well located five meters away. Samples taken from multilevel sampling points located along flow lines between the two wells were analyzed to determine the concentrations of tracers and of volatile organic contaminants. Tracer breakthrough data were fitted to an approximate analytic solution to determine average linear velocities and dispersatives. The concentration histories obtained for three volatile organic contaminants deviate significantly from that predicted using local equilibrium-based transport models. Comparison with results of a one-dimensional, kinetics-based transport model indicates qualitative agreement between observed behavior and that expected for solutes affected by a first-order reversible sorption process for which the rate constants are small relative to the groundwater velocity in the induced flow field. (Author's abstract)
W90-00873

EVALUATION OF GROUNDWATER VULNERABILITY TO PESTICIDES: A COMPARISON BETWEEN THE PESTICIDE DRASTIC INDEX AND THE PRZM LEACHING QUANTITIES.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W90-00877

DRINKING WATER STANDARDS AND RISK ASSESSMENT.
Environmental Protection Agency, Washington, DC. Office of Water Supply.
J. A. Cotruvo.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 6-12, February 1989. 2 fig, 1 tab, 2 ref.

Descriptors: *Water treatment, *Risk assessment, *Drinking water, *Water quality standards, United States, Policy aspects, Decision making.

The role and use of risk assessment methods in the establishment of drinking water standards are described, with emphasis on recent applications in the USA. The process essentially includes an attempt to quantify human exposure from all routes including drinking water, animal toxicology and human epidemiology, when available, to arrive at drinking water concentrations at which exposure would result in 'no known or anticipated adverse effects on health, with a margin of safety'. The process itself is straightforward; however, the application to decision making for substances which are considered to be potentially non-threshold acting in their toxicity (e.g. carcinogenic) requires many policy choices beyond the scientific data, and is subject to considerable controversy. (Author's abstract)
W90-00922

WATER RECREATION AND RISK.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 4C.
W90-00923

GROUNDWATER POLLUTION AND THE DISPOSAL OF HAZARDOUS AND RADIOACTIVE WASTES.
For primary bibliographic entry see Field 5E.
W90-00926

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ACID DEPOSITION: RESEARCH, INFORMATION, POLICY: A COLLOQUIUM. THE ROLE OF RESEARCH IN POLICY DEVELOPMENT: AN INDUSTRIAL PERSPECTIVE.
For primary bibliographic entry see Field 5B.
W90-00067

ACID DEPOSITION RESEARCH AND POLICY.
Kentucky Energy Cabinet, Lexington. Dept. for Energy Research and Development.
For primary bibliographic entry see Field 5B.
W90-00069

ACID DEPOSITION PROGRAM: SCOPE OF WORK.
Virginia State Air Pollution Control Board, Richmond.
For primary bibliographic entry see Field 5B.
W90-00072

GLEN CANYON ENVIRONMENTAL STUDIES: EXECUTIVE REVIEW COMMITTEE FINAL REPORT.
Glen Canyon Environmental Studies, Flagstaff, AZ.
For primary bibliographic entry see Field 6G.
W90-00095

DECISION MAKING USING A DROUGHT SEVERITY INDEX.
Australian National Univ., Canberra. Dept. of Geography.
N. S. McDonald.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 131-139, 3 fig, 1 tab, 8 ref.

Descriptors: *Data collections, *Water resources data, *Decision making, *Data interpretation,

*Drought, *Agricultural hydrology, Water shortage, Water demand, Rainfall, Meteorology.

Given the episodic and variable nature of precipitation, droughts are a frequent risk to agricultural production. Droughts are usually defined as a water shortage either quantitatively based on meteorological data or quantitatively in terms of the demand for water or the impact of water shortages. The integration of these two components is seldom addressed. Using climatic data, drought severity and incidence is determined by the Palmer Index. The impact of drought is measured by the frequency and timing of formal drought declaration based on pasture condition. Regional scale analysis of droughts over New South Wales form the data base. The association between 'meteorological' drought and its resultant impact is examined particularly in relation to conditions at the drought commencement. The nature of this association can be used as a decision making tool by the various agencies in their response to drought. (See also W90-00100) (Author's abstract)
W90-00110

EVALUATION THE EFFECT OF CLIMATIC VARIABILITY ON MANAGEMENT OF DRYLAND AGRICULTURAL SYSTEMS IN NORTH-EASTERN AUSTRALIA.
Queensland Dept. of Primary Industries, Brisbane (Australia).
For primary bibliographic entry see Field 3F.
W90-00117

DESIGNING COST-EFFECTIVE HABITAT MANAGEMENT PLANS USING OPTIMIZATION METHODS.
National Ecology Center, Fort Collins, CO.
A. H. Farmer, S. C. Matulich, and J. E. Hanson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-166748. Price codes: A05 in paper copy, A01 in microfiche. Report No. REC-ERC-88-5, August 1988. 76p, 22 fig, 4 tab, 26 ref, 3 append.

Descriptors: *Wildlife habitats, *Wetlands, *Linear programming, *Systems analysis, *Wildlife management, *Management planning, *Cost analysis, Wildlife, Mathematical studies, Wetlands, Grasslands, Mathematical models, Birds, Revegetation, Livestock, Land acquisition, Computer programs, Optimization.

This report describes the use of optimization methods for designing cost-effective wildlife management plans. Many management problems require decisions about which management activities, and how much of each, to implement to achieve a prescribed wildlife response at minimum possible cost. An example wildlife management problem involving wetland and grassland habitats is used to introduce concepts of linear programming. Following this example, separable programming model for the Garrison Diversion Unit is described in detail. This model is used to develop management plans for three species (blue-winged teal, gadwall, and Hungarian partridge) based on several activities including land acquisition (fee title, easement), planting vegetation (dense nesting cover, native grasses, tame grasses), livestock grazing, and wetland development (wetland construction and restoration). Guidance is provided on the organization and computer coding of a separable programming model. (Author's abstract)
W90-00123

REMISS: RESEARCH MANAGEMENT INFORMATION SYSTEM.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 10D.
W90-00129

ACID RAIN: DELAYS AND MANAGEMENT CHANGES IN THE FEDERAL RESEARCH PROGRAM.
General Accounting Office, Washington, DC. Resources, Community and Economic Development Div.
For primary bibliographic entry see Field 5B.
W90-00138

SIDE EFFECTS OF WATER RESOURCES MANAGEMENT.
For primary bibliographic entry see Field 6G.
W90-00160

BLUEPRINT FOR THE ENVIRONMENT: A PLAN FOR FEDERAL ACTION.
For primary bibliographic entry see Field 5G.
W90-00161

NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT IN INDONESIA: AN OVERVIEW.
Agency for International Development, Washington, DC.
J. Tarrant, E. Barbier, R. J. Greenberg, M. L. Higgins, and S. F. Lintner.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-106348. Price codes: A04 in paper copy, A01 in microfiche. Report No. PN-AA2-183, October 1987. 341p, 7 append.

Descriptors: *Environmental policy, *Indonesia, *Natural resources, *Management planning, *Environmental protection, Economic aspects, Social aspects, Forestry, Watershed management, Ecosystems, Pesticides, Agriculture, Water pollution prevention.

In Indonesia, the government's economic policies, the objectives of private businesses, and the socioeconomic interests of local communities coincide in viewing natural resources as commodities for production and export to the detriment of the natural resource base. The comprehensive overview of Indonesian policies and their effects on long-term goals for natural resource management focuses on: (1) the continuing deforestation of tropical hardwoods at a rate of 0.6 to 1.0 million hectare (ha) annually; (2) the degradation of 36 of Indonesia's 125 watersheds; (3) the loss of biological diversity through non-conservation of the habitat of rare and endangered species; (4) the increasing reliance of agriculture on pesticides; (5) the decline of water quality and supply due to upstream agricultural, industrial, and urban management practices; and (6) the increase in liquid and solid toxic wastes from industrial and processing activities. (Author's abstract)
W90-00250

INTERDISCIPLINARY PROCESS FOR PROTECTING INSTREAM FLOWS.
Bureau of Land Management, Denver, CO.
W. L. Jackson, B. Shelby, A. Martinez, and B. P. Van Haveren.
Journal of Soil and Water Conservation JSWCA3, Vol. 44, No. 2, p 121-126, March-April 1989. 35 ref.

Descriptors: *Instream flow, *Water resources development, *Alaska, *Arizona, *Interdisciplinary studies, *Resource allocation, Conservation, Streams, Water rights, Legal aspects, Comprehensive planning.

A new, comprehensive, interdisciplinary approach has been established for determining and protecting instream flow needs. This approach was based upon relationships between flows and water-dependent resource values, but also incorporated legal, technical, and administrative aspects of water management. It recognized that resource values and their related physical, legal, and administrative environments differed widely among rivers and relied on professional analysis, interdisciplinary interaction, and expert judgement for these differences. The new approach differed from other approaches to determining instream flow needs because it emphasized the assessment process more than specific assessment methods. This approach has been applied to instream flow assessments in Beaver Creek National Wild River in central Alaska and the San Pedro River Riparian Conservation Area in southern Arizona. The value-based, interdisciplinary process for determining and protecting instream flow needs consisted of six basic steps: (1) preliminary assessment and study design, (2) description of flow-dependent values, (3) description and quantification of hydrology and geomorphology, (4) description of the effects of flows on resource values, (5) identification of minimum flows to protect values, and (6) development of a strategy to protect flows. Throughout, the evaluation and quantification process was interactive with a group of specialists constructing an interdisciplinary product. (Mertz-PTT)
W90-00334

INFORMATION REQUIREMENTS OF INTEGRATED ENVIRONMENTAL POLICY EXPERIENCES IN THE NETHERLANDS.
Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 7A.
W90-00455

DESTRUCTION OF THE AGRICULTURAL ENVIRONMENT IN LOWER SILESIA, POLAND.
Academy of Economics, Wroclaw (Poland). Dept. of Economic Geography.
K. R. Mazurski.
Biological Wastes BIWAED, Vol. 27, No. 4, p 245-255, 1989. 1 fig, 7 ref.

Descriptors: *Urbanization, *Poland, *Agriculture, *Pollution index, *Regional planning, Air pollution, Water pollution, Evaluation, Data interpretation, Environmental impact.

The hazards to, and damages imposed on, the agricultural environment have been analyzed using Lower Silesia in Poland as an example. Using unpublished data from the sanitary-epidemiological stations of the districts as well as data obtained from the departments of environmental protection, geology and natural resources of the district offices, a methodological index was devised that would provide a synthetic characterization of the negative transformations (destruction) in the area utilized by agriculture. It was determined that the emission of gases penetrating the whole agricultural environment is progressing with great speed. The pollution of open, superficial and underground waters is also very high. The bioactive soils of Lower Silesia are exposed to two principle danger: chemical contamination caused by air and water; and the exploitation of rock and post-glacial sands and gravels for urbanization and road building which encroaches on farmland. The impact of particular factors on the quality of the environment is not fully known. Therefore, mathematical operations were introduced to correct results obtained and reduce them to an approximately common level. The sum obtained after adding the results is the destruction index of the agricultural environment. The lower the value calculated for the index, the greater the destruction. The index includes: Stimulants (positive values) such as water-supply lines, natural wasteland, and woodlands; and Anti-stimulants (negative values) such as dust pollution, arable land, human activity, and building surface area. This method makes it possible to determine in an objective way the relative amount of ecological damage in the agricultural environment and its extent in space. (White-Reimer-PTT)
W90-00525

WATER SUPPLY: QUALITY, ECONOMICS AND PLANNING FOR THE FUTURE.
D. Kinnersley.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 2, p 65-68, June 1989.

Descriptors: *Water treatment facilities, *Future planning, *Water supply, *Water quality, *Water management, Economic aspects, Project planning, Drinking water, Water reuse, France, Maintenance, Public opinion, Great Britain, Social aspects.

In an address to a water conference held in New England, the author discusses several topics concerned with supplying water of good quality into the twenty-first century. As a viable trend to water management in two-thirds of metropolitan France, water supply organizations are generally in the control of local municipalities who franchise water supply operations to private organizations. Sustained good quality of water depends on the control of many factors such as river and groundwater quality, controlling pollution sources, and properly maintaining water treatment and distribution systems. While water quality standards are now being set in more detail nationally or even internationally, water remains a local natural resource, with individual character, calling for local regulation of water quality parameters. Other factors that need to be considered for the future are the cost of water at the tap, the durability of equipment, and public attitudes towards maintaining water quality. Careful management of equipment and water supply facilities is needed to not spend too much or too little on maintenance. In the future water supply leaders and the private sector must not just see regulation as an extra problem, but as a part of planning for the future. (Geiger-PTT)
W90-00650

SOCIAL CHOICE, RISK AND DETERMINATION IN WATER QUALITY MANAGEMENT.
Canberra Coll. of Advanced Education, Belconnen (Australia). School of Applied Science.
P. Cullen.
Hydrobiologia HYDRB8, Vol. 176/17, p 1-5, July 3, 1989. 2 tab, 10 ref.

Descriptors: *Water quality management, *Lakes, *Natural resources, *Social aspects, *Nutrients, *Model studies, Phosphorus, Runoff.

The identification of strategies for natural resource management, in terms of both social and technical choices, is discussed. In attempting to predict the likely water quality of a lake following some intervention to control nutrient inflow, or in attempting to predict the likely water quality in a proposed new impoundment, it is important to appreciate the probabilistic nature of such predictions. The OECD-Vollenweider models require an estimate of phosphorus inflow to the water body, and these inflows will be partly a function of runoff from the catchment. Since the rainfall (and therefore runoff) varies so much from year to year in climates such as Australia, it seems unwise to base predictions on some average rainfall or runoff value when the long-term average may be experienced only rarely. A better approach seems to be to look at the range of runoff values, and apply the OECD-Vollenweider model to dry, normal and wet periods, and develop trophic state predictions for each hydrologic state. Since water quality is probabilistic rather than deterministic (as implied by the models), then levels of acceptable risk have to be established. Is it acceptable for an impoundment to have a cyanobacterial bloom each year every decade. These are questions of social choice, and require the public to be involved in choosing between the various possible performances of the water body. The trade-off between cost and acceptable water quality is not one that can be made by professionals alone. In such questions of social choice, society can expect the professionals to assist them in understanding the various trade-offs, not to make political choices under the guise of technical analysis. (Author's abstract)
W90-00695

PRACTICAL PERFORMANCE OF VARIOUS SYSTEMS FOR SMALL-SCALE WASTEWATER TREATMENT DURING A TWO-YEAR FIELD TEST.
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5D.
W90-00746

DEVELOPMENT AND APPLICATION OF A MODEL FOR REGIONAL WATER QUALITY MANAGEMENT.
Minho Univ., Braga (Portugal). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W90-00835

FLOODING AND THE QUANTIFICATION OF 'INTANGIBLES'.
Middlesex Polytechnic, London (England). Flood Hazard Research Centre.
C. H. Green, and E. C. Penning-Rowsell.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 1, p 27-30, February 1989. 2 fig, 1 tab, 19 ref.

Descriptors: *Cost-benefit analysis, *Flood control, Economic aspects.

Sources of both systemic and parameter uncertainties in flood alleviation cost-benefit analysis are discussed. Cost-benefit analyses are assessments of the future effects of different scheme options; consequently, there are inherent uncertainties. The omission of consideration of some impacts as 'intangibles', because it has not been possible to measure them, is a form of systemic uncertainty. A significant omission in the past from flood alleviation cost-benefit analyses has been the non-monetary impacts of flooding upon households. It is shown that these impacts are both large and more important to the households affected than are the direct monetary losses. (Author's abstract)
W90-00925

LIMITATION OF THE FORECASTING HORIZON IN STOCHASTIC DYNAMIC PROGRAMMING FOR DAM OPERATION (LIMITATION DE L'HORIZON PREVISIONNEL DE LA PROGRAMMATION DYNAMIQUE STOCHASTIQUE EN MATIERE DE GESTION DE BARRAGES).
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 4A.
W90-00938

DYNAMIC PROGRAMMING: APPLICATION TO MANAGEMENT OF AN IRRIGATION RESERVOIR (PROGRAMMATION DYNAMIQUE: APPLICATION A LA GESTION D'UNE RETENUE POUR L'IRRIGATION).
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 4A.
W90-00939

OPERATION OF WATER SUPPLY RESERVOIRS BY 'CONTROL BANDS' DERIVED BY SIMULATION.
Durban-Westville Univ. (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-00941

6B. Evaluation Process

PERCIVAL CREEK CORRIDOR PLAN.
Thurston Regional Planning Council, Olympia, WA.
S. W. Morrison.
Journal of Soil and Water Conservation JSWCA3, Vol. 43, No. 6, p 465-467, November-December 1988. 3 ref.

Descriptors: *Comprehensive planning, *Optimum development plans, *Environmental protection, *Environmental policy, Management planning, Washington, Streams, Wildlife habitats, Economic aspects.

In an attempt to guide future land use decisions along Percival Creek and the Black Lake Drainage Ditch, which run through Thurston county, Washington, the Percival Creek Corridor Plan was initiated in the spring of 1984. The waterways run within the shadow of the Washington State Capitol dome and are abundant in water, wetlands, and related natural resources. The primary goal of the plan was to strike a balance between long-term protection of the creek ecosystem and urban infrastructure necessary to meet the region's economic needs. The corridor plan sought to resolve shoreline and zoning conflicts through the use of a combined regulatory approach called a management unit. Accomplishments of the corridor plan include: (1) as severely limited land use within the canyon, drainage way, and associated wetlands; (2) establishment of a vegetative buffer; (3) expansion of the influence of shoreline regulations; (4) limitations on the location of new or expanded roads, maintenance of habitat values and water quality, encouragement of best management practices for animal keeping; and (5) exploration of potential recreational opportunities within the corridor through an intergovernmental approach. A joint stormwater management plan is now planned for the Percival Creek watershed. The Percival Creek corridor plan is an example of cooperative problem-solving by consensus. (Mertz-PTT)
W90-00326

PROBLEMS OF ORGANIZATION IN THE SCIENCE, POLITICS AND MANAGEMENT OF WATER.
Rawson Academy of Aquatic Science, Ottawa (Ontario).
R. L. Thomas.
Hydrobiologia HYDRB8, Vol. 176/17, p 7-16, July 3, 1989. 1 fig, 1 tab.

Descriptors: *Water management, *Resources management, *Natural resources, *Political aspects, Life cycles, Scientific personnel.

Water management is a complex multidisciplinary function involving scientists, politicians and bureaucrats. The general characteristics of these groups are discussed in an effort to understand how current scientific programs are impacted by varying degrees of control exerted by these divergent groups. In an effort to understand how science impacts upon resource management, a generalized institutional life cycle is presented and the possible role of the scientist in management is defined. Science organizations directed towards research should report to a board, council or commission composed of the best minds int he disciplinary areas mandated for the organization. They should not be directly in a line management system in which research may be downgraded to information gathering devoid of basic processing understanding. Managers should be appointed for a fixed term only and should be allowed to return to research, and the position rotated. During the appointment period, the manager should be allowed time to maintain his research standing during the period of office. All capable scientists should recognize that an appointment of this sort is a necessary part of being a member of the research fraternity. Some form of reward or recognition should be accorded to those who accept the increased, and often difficult, responsibilities for research management. Research budgets should not follow job estimations developed for engineering studies. By all means, there must be a limit to resources. (Miller-PTT)
W90-00696

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER AND WASTEWATER FINANCE AND PRICING.
Young (Arthur) and Co., Charlotte, NC.
For primary bibliographic entry see Field 5D.
W90-00176

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE--A PROTOTYPE FOR NATIONWIDE IMPLEMENTATION.
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7A.
W90-00195

6D. Water Demand

TOTAL WATER AND TAPWATER INTAKE IN THE UNITED STATES: POPULATION-BASED ESTIMATES OF QUANTITIES AND SOURCES.
National Cancer Inst., Bethesda, MD. Epidemiology and Biostatistics Program.
A. G. Ershow, and K. P. Cantor.
May 1989. 140p, 8 fig, 72 tab, 33 ref, 6 append. National Cancer Institute Contract 263-MD-810264.

Descriptors: *Drinking water, *Water use, *Water demand, *Data collections, Potable water, Statistical methods, Statistical analysis.

This report presents estimates of Total Water and Tapwater intake in the population of the continental United States. The methods used to derive the estimates are described in detail. The data used for this analysis were collected during the 1977-78 Nationwide Food Consumption Survey (NFCS) of the U.S. Department of Agriculture. The authors created a special database to quantify the total moisture and tapwater content of the foods and beverages consumed by the NFCS study subjects. All food and beverage sources, as well as drinking water, are incorporated in the estimates of Total Water intake. Estimates of Tapwater intake include drinking water and tapwater added in final home or restaurant preparation of beverages and foods. Data are presented by age group, sex, season and geographic region, and separately for pregnant women, lactating women, and breast-fed children. Average intake for all participants (n=26,081) (excluding pregnant women, lactating women, and breast-fed children) was 2,072 +or- 803 gallons/day (gpd) of Total Water, including 1,193 +or-702 gpd of Tapwater. Tapwater intake thus accounted for 55 +or- 18% of Total Water consumed. For all age groups combined, drinking water contributed approximately 30% of Total Water and 54% of Tapwater; foods, 26% of Total Water and 10% of Tapwater; and other beverages, 44% of Total Water and 36% of Tapwater. Median daily Total Water intake, by age group, was 1,120 g (< 1 year), 1,497 g (1-10 yrs), 1,874 g (11-19 yrs), 2,109 g (20-64 years), and 2,109 g (65+ yrs). Median daily Tapwater intake was 240 g (< 1 yr), 665 g (1-10 yrs), 867 g (11-19 yrs), 1,252 g (20-64 yrs), and 1,367 g (65+ yrs). Among adults 20-64 years old, the 5th and 95th percentiles of Total Water consumption were 1,333 g and 3,793 g. Comparable percentiles of Tapwater intake were 416 g and 2,707 g, respectively. Observation of expected trends for sex, geographical region, and season, as well as for age, reinforces the general usefulness of this approach. (Author's abstract)
W90-00097

POTENTIAL DEMAND FOR SUPPLEMENTAL IRRIGATION IN THE LOWER MISSISSIPPI VALLEY.
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness.
For primary bibliographic entry see Field 3F.
W90-00332

INTERDISCIPLINARY PROCESS FOR PROTECTING INSTREAM FLOWS.
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 6A.
W90-00334

RESEARCH NEEDS IN IRRIGATION AND DRAINAGE--1989.
For primary bibliographic entry see Field 3F.
W90-00893

6E. Water Law and Institutions

ACID RAIN 1986: A HANDBOOK FOR STATES AND PROVINCES.
For primary bibliographic entry see Field 5B.
W90-00063

SAVE THE RAIN.
Natural Resources Defense Council, Inc., New York.
For primary bibliographic entry see Field 5G.
W90-00066

LEGISLATING A FAIR AND EFFECTIVE NATIONAL ACID DEPOSITION CONTROL PROGRAM: AN OHIO PERSPECTIVE.
Ohio Consumers' Counsel Governing Board, Columbus.
For primary bibliographic entry see Field 5G.
W90-00071

WISCONSIN ACID DEPOSITION PROGRAM.
Wisconsin Dept. of Natural Resources, Madison. Bureau of Air Management.
For primary bibliographic entry see Field 5G.
W90-00073

WHAT WE KNOW/WHAT WE DID/WHY/WHAT WE WILL DO (ABOUT ACID RAIN).
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5G.
W90-00075

ACID PRECIPITATION ISSUE: HAVE WE LOST SIGHT OF PAST LESSONS.
Quebec Ministere de l'Environnement, Sainte-Foy.
For primary bibliographic entry see Field 5G.
W90-00076

DRINKING WATER CRITERIA DOCUMENT FOR POLYCHLORINATED BIPHENYLS (PCBS): 1987 REVIEW OF THE DRAFT FINAL.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
For primary bibliographic entry see Field 5G.
W90-00085

EPA: GROUND WATER HANDBOOK.
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W90-00087

SITE CHARACTERIZATION: TECHNICAL APPROACHES TO RCRA COMPLIANCE.
Battelle Pacific Northwest Labs., Richland, WA. Site Characterization and Assessment Section.
For primary bibliographic entry see Field 5G.
W90-00091

DEVELOPMENT DOCUMENT FOR FINAL EFFLUENT GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE ORE MINING AND DRESSING POINT SOURCE CATEGORY: GOLD PLACER MINE SUBCATEGORY.
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
For primary bibliographic entry see Field 5G.
W90-00096

STATUS REPORT ON FLOOD WARNING SYSTEMS IN THE UNITED STATES.
Colorado Univ., Colorado Springs.
For primary bibliographic entry see Field 6F.
W90-00452

WATER FARMS AND TRANSFER CONFLICTS IN ARIZONA, USA: A PROPOSED RESOLUTION PROCESS.
Department of Geography and Regional Development, University of Arizona, Tucson, AZ 85721.
J. McEntire.
Environmental Management EMNGDC, Vol. 13, No. 3, p 287-295, May-June 1989. 36 ref.

Descriptors: *Water law, *Groundwater management, *Legal aspects, *Legislation, *Water transfer, *Arizona, Groundwater Management Act, Water farms, Groundwater depletion, Groundwater potential.

The 1980 Groundwater Management Act (Arizona) and the state legislature's reactions to the predicaments produced by water farms are reviewed. Water is a relatively scarce resource in Arizona, especially since the recent urban booms of Phoenix and Tucson. Arizona's 1980 Groundwater Management Act was the precursor to current water-transfer conflicts between urban buyers, rural farmers and third parties. Water farms are bought with the intention to transfer their appurtenant groundwater to the two major metropolitan cities. As water markets have emerged, differing values and public interest issues have become apparent, while the state legislature attempts to resolve inequities. Site-specific transfer disputes, as well as policy-making conflicts, offer suitable situations for a mediation process. Equity-based and efficiency-based criteria are suggested as the basis for resolving water-transfer conflicts, and remediation process is proposed. However, third parties must develop an agenda, and a balance of power should be attained before mediation can effectively forge an agreement on water-transfer policies. The attainment of statewide policies generated through a mediated process has the potential to expand long-range regional water planning and management. (Author's abstract)
W90-00453

CONFLICT, CONTROVERSY, AND COMPROMISE: THE CONCHO WATER SNAKE (NERODIA HARTERI PAUCIMACULATA) VERSUS THE STACY DAM AND RESERVOIR.
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 6G.
W90-00454

PROBLEMS OF ORGANIZATION IN THE SCIENCE, POLITICS AND MANAGEMENT OF WATER.
Rawson Academy of Aquatic Science, Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W90-00696

FUTURE IRRIGATION PROSPECTS AND ACTIONS IN DEVELOPING COUNTRIES.
International Bank for Reconstruction and Development, Washington, DC. Agriculture Production and Services Div.
For primary bibliographic entry see Field 3F.
W90-00888

6F. Nonstructural Alternatives

STATUS REPORT ON FLOOD WARNING SYSTEMS IN THE UNITED STATES.
Colorado Univ., Colorado Springs.
E. Gruntfest, and C. Huber.
Environmental Management EMNGDC, Vol. 13, No. 3, p 279-286, May-June 1989. 1 fig, 1 tab, 9 ref. NSF grant no. CES-8713629.

Descriptors: *Flood warning systems, *Flood protection, *Regional floods, *Warning systems, *Flash floods, Flood damage, Dam failure.

One of the major changes in flash-flood mitigation in the past decade is the number of communities that have implemented warning systems. A survey was conducted of 18 early-warning systems in the United States developed by communities of regions to provide protection against flash floods or dam failures. Problems revealed included the following: (1) equipment malfunctions, (2) inadequate maintenance funding, (3) inconsistent levels of protection and expenditure, (4) inconsistent levels of expectations and formalization, (5) varying levels of local commitment to the systems, (6) under-emphasis on response capability, and (7) a tendency to over-rely on warning systems. Some unanticipated benefits experienced by the survey communities were also revealed: (1) the warning systems serve as valuable data collection tools, (2) a great deal of interagency cooperation has been demonstrated, and (3) warning systems offer increased alternatives to structural modification projects. The inter-jurisdic-

tional nature of drainage basins, the evolving roles of the various federal agencies involved in flood mitigation, and the lack of governmental standards of operations for flood warning systems are issues that must be considered as communities make decisions regarding the adoption of warning systems. The record on these systems is too short for a precise assessment if how successful they are; however, results indicate that if the goal of reducing loss of life and property from flooding is to be achieved, warning systems must be only one part of a comprehensive flood loss reduction program. (Author's abstract)
W90-00452

COPING WITH THE EFFECTS OF HIGH WATER LEVELS ON PROPERTY HAZARDS: NORTH SHORE OF LAKE SUPERIOR.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
H. Rasid, R. S. Dilley, D. Baker, and P. Otterson.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 2, p 205-216, 1989. 2 fig, 4 tab. 17 ref.

Descriptors: *Flood protection, *Flood damage, *Flooding, *Lake Superior, *Flood control, *Erosion control, Flood plain zoning, Shore protection, Planning.

Property hazards associated with the 1985-86 high-water levels on the north shore of Lake Superior between Duluth, Minnesota, and Thunder Bay, Ontario, are examined. Data on composition of bluff/shore materials, recession rates, property setbacks, and existing shore protection structures were obtained from questionnaire surveys. Estimated long-term bluff/shoreline recession rates vary from less than 3 m to more than 15 m over a minimum period of 5 years, with a substantial amount of erosion occurring during the 1985-86 high water period. Approximately 39 percent of the respondents protected their properties with structural devices, but many were ineffective. Many respondents perceived lower water levels as a higher priority than providing shore protection structures. However, human ability to manipulate the levels of Great Lakes is limited, since lake levels are dependent primarily on climatic cycles. Because of the limitations on controlling water levels, master plans for land use regulations should be developed to prevent or minimize future encroachment of properties upon flood-prone and erosion-prone reaches of the shoreline. (Author's abstract)
W90-00840

FLOODING AND THE QUANTIFICATION OF 'INTANGIBLES'.
Middlesex Polytechnic, London (England). Flood Hazard Research Centre.
For primary bibliographic entry see Field 6A.
W90-00925

6G. Ecologic Impact Of Water Development

SETTLEMENT, SUBSISTENCE, AND SPECIALIZATION IN THE NORTHERN PERIPHERY: THE WADDELL PROJECT, VOLUME 1.
Archaeological Consulting Services Ltd., Tempe, AZ.
Archaeological Consulting Service, Ltd., Tempe, AZ. Cultural Resources Report No. 65, 1989. 642p, 71 fig, 75 tab. Bureau of Reclamation Contract No. 6-CS-30-044250.

Descriptors: *Arizona, *Water resources development, *Archaeology, *Social aspects, Lake Pleasant, New Waddell Dam, Dams, Agriculture, Soil properties, Water supply, Hohokam Indians, History.

Under the sponsorship of the Bureau of Reclamation, the New Waddell Dam Borrow Areas Mitigative Data Recovery Project, more simply known as the Waddell Project, performed data recovery at 17 sites in the vicinity of Lake Pleasant, Arizona. The project area, composed of multiple survey areas, was spread across two drainages, the Agua Fria and New River, in what is considered the northern periphery of the prehistoric Hohokam culture. The sites studied included large agricultural fields, sometimes with associated surface masonry field houses; farmsteads with small numbers of pithouses; resource procurement and processing sites; and a single special-purpose crematory site. Research efforts were organized into three broad topic areas so that all project researchers, including specialists, could gear their investigations along the same lines. At the intra-drainage level, the focus was on the individual sites and their locations with respect to the physical environment and each other. Terminology employed for agricultural features and systems in the literature was reviewed and it was proposed that the use of terms be standardized. The topographic situation, source of water (e.g., river, wash, and/or runoff), and soil conditions were identified for the different agricultural systems investigated. The functions of the various agricultural feature types were assessed. A model of the development of any agricultural system was employed that helps account for the functions of certain enigmatic features and aspects of features. Volume one of this report provides an: introduction and research framework for the Waddell Project; a description of the environmental setting; site and survey descriptions for 15 of the study sites; and a description of the supplemental survey tasks. (See also W87-09094 and W90-00082) (Lantz-PTT)
W90-00081

SETTLEMENT, SUBSISTENCE, AND SPECIALIZATION IN THE NORTHERN PERIPHERY: THE WADDELL PROJECT, VOLUME 2.
Archaeological Consulting Services Ltd., Tempe, AZ.
Archaeological Consulting Service, Ltd., Tempe, AZ. Cultural Resources Report No. 65, 1989. 547p, 46 fig, 74 tab, 750 ref, 4 append. Bureau of Reclamation Contract No. 6-CS-30-044250.

Descriptors: *Arizona, *Water resources development, *Archaeology, *Social aspects, Lake Pleasant, New Waddell Dam, Dams, Agriculture, Soil properties, Water supply, Hohokam Indians, History.

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W90-00082

GLEN CANYON ENVIRONMENTAL STUDIES: EXECUTIVE REVIEW COMMITTEE FINAL REPORT.
Glen Canyon Environmental Studies, Flagstaff, AZ.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119622. Price codes: A06 in paper copy, A01 in microfiche. Report No. GCES/01/88, May 1988. 129p, 1 fig, 5 append.

Descriptors: *Dam effects, *Water resources management, *Glen Canyon, *Colorado River, Grand Canyon, Environmental effects, Management planning, Public policy.

This Final Report contains recommendations of the Executive Review Committee, a management and policy level group representing the Bureau of Reclamation, National Park Service, Fish and Wildlife Service, Department of the Interior (Office of Environmental Project Review), and Western Area Power Administration to the Department of the Interior regarding future actions to be taken based on the technical results of the Glen Canyon Environmental Studies. The objectives and focus of each of these agencies in the management of the Colorado River through Glen and Grand Canyons is outlined and recommendations are given for Secretarial consideration on the need for operational changes at Glen Canyon Dam and additional monitoring and/or study. Individual agency position statements, recommendations, findings, management objectives and priorities, and constituent group comments are included as appendices. The report also contains the transmittal letters that reflect the actions to be taken by the cooperating agencies and bureaus. (Author's abstract)
W90-00095

INTAKE STRUCTURE OPERATION STUDY, LOST CREEK DAM, OREGON.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Div.
For primary bibliographic entry see Field 8A.
W90-00099

IMPACTS OF A PROPOSED COAL MINE IN THE FLATHEAD RIVER BASIN.
International Joint Commission-United States and Canada, Washington, DC.
For primary bibliographic entry see Field 4C.
W90-00128

HOMESTEADING IN THE DEPRESSION: A STUDY OF TWO SHORT-LIVED HOMESTEADS IN THE HARQUAHALA VALLEY, ARIZONA.
Northland Research, Inc., Flagstaff, AZ.
P. H. Stein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-164834. Price codes: A07 in paper copy, A01 in microfiche. 1988. 125p, 22 fig, 1 tab, 66 ref, 2 append. Bureau of Reclamation Contract 3-PA-30-00740.

Descriptors: *Dry farming, *Archaeology, *Arizona, Harquahala Valley, History, Water resources development.

A data recovery program was conducted at two historic sites which were affected by the construction of the Upper West Side Canal and Centennial Levee of the Central Arizona Project. Both sites are located in the Harquahala Valley of western Maricopa County, Arizona. Site AZ S:7:29(ASM) was the Enlarged (Dry Farm) Homestead of Hugh T. Stubblefield. It was occupied from 1930 or 1931 to mid-1933. Site AZ S:7:32(ASM) was the Enlarged (Dry Farm) Homestead of Lyman C. Mason and was occupied from 1929 to early-1930 or mid-1930. Data recovery at the Stubblefield and Mason homesteads had several goals. The first was to document, in a systematic and intensive manner, the architecture and material culture of the sites, because both would be destroyed by the Central Arizona Project features. The second was to derive culture histories for the sites using archival,

interview, and archaeological data sets. Beyond these immediate goals, data recovery focused on the collection of data relevant to four areas of research interest. Three of these dealt with the sensitivity of archaeological data to the behavioral systems which generated them. The fourth examined the relationship of ideal behavior, as structured by national homestead laws, to actual behavior, as seen in the interpretation and application of such laws at the local level. (Author's abstract)
W90-00131

HOHOKAM ARCHAEOLOGY ALONG PHASE B OF THE TUCSON AQUEDUCT CENTRAL ARIZONA PROJECT. VOLUME 2: EXCAVATIONS AT FASTIMES (AZ AA:12:384), A RILLITO PHASE SITE IN THE AVRA VALLEY.
Arizona State Museum, Tucson. Cultural Resource Management Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-175483. Price codes: A15 in paper copy, A01 in microfiche. Arizona State Museum Archaeological Series No. 178, 1988. 330p, 69 fig, 63 tab, 162 ref. Bureau of Reclamation Contract 6-CS-30-03500.

Descriptors: *Resources development, *Aqueducts, *Archaeology, *Social aspects, *Hohokam Indians, Tucson Aqueduct, History, Arizona.

In 1986 archaeologists excavated a Rillito phase Hohokam settlement that lay in the path of the Tucson Aqueduct Phase B, Central Arizona Project. Trenching and stripping revealed 96 features, including at least 30 pit houses. Thirty-eight features were excavated or tested: 17 pit houses, 6 cremations, 2 inhumations, 8 roasting pits, and 5 other pit features. The features were distributed among five distinct house groups, some which had one or more house clusters. The total site area was 164,300 sq m. The variety of artifactual and nonartifactual materials analyzed indicates that these sites probably represents five farmsteads, all occupied during the relatively unstudied Rillito phase (A.D. 700 to 900) of the Colonial period. Some of the structures were occupied year-round, but site use may have lasted only a generation or two. Exact contemporaneity of the house groups could not be determined, but in some cases the general building sequences within groups could tentatively be reconstructed. (Lantz-PTT)
W90-00143

TERRESTRIAL ECOLOGY OF LOWER COLORADO RIVER BANKLINE MODIFICATIONS.
SWCA, Inc., Tucson, AZ.
G. S. Mills, and J. A. Tress.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-180268. Price codes: A10 in paper copy, A01 in microfiche. Final Report, November 28, 1988. 191p, 26 fig, 57 tab, 77 ref, 3 append. Bureau of Reclamation Contract 6-CS-30-02860.

Descriptors: *Bank stabilization, *Ecological effects, *Ecosystems, *Colorado River, *Stream banks, Riparian vegetation, Wildlife, Riprap, Birds, Revegetation.

A study to evaluate impacts of existing bankline stabilization procedures along the Lower Colorado River on terrestrial wildlife was undertaken. Objectives of the study included a literature review of bankline stabilization mechanisms and their effects on wildlife, a summary of historical information on the bankline modification along the Lower Colorado River, an evaluation of vegetation succession on riprapped banklines, and experiments in revegetation of riprapped banklines. Major findings of the study were: (1) little of the extensive literature pertaining to bankline habitats appears to be relevant to the Lower Colorado River; (2) most of the riprap along the Lower Colorado River is similar in physical characteristics; (3) natural vegetation on riprap is dominated by arrowweed and saltcedar; (4) bird densities and numbers of species on riprapped banklines were significantly affected by volume of vegetation and adjacent vegetation ion summer and winter; and (5) revegetation experiments involving trees and Atriplex seeds were most successful on the top edge or immediately behind riprap and not on the riprap itself. The overall conclusion of the study was that attempting to revegetate riprapped banklines for wildlife is not cost-effective. Revegetation of nearby areas appears to be as beneficial to wildlife, is less expensive, and does not conflict with bankline maintenance activities. (Author's abstract)
W90-00148

HISTORICAL ARCHAEOLOGICAL INVESTIGATIONS AT DAM CONSTRUCTION CAMPS IN CENTRAL ARIZONA: SECOND ANNUAL REPORT.
Dames and Moore, Phoenix, AZ.
December 1988. 130p, 33 fig, 7 tab, 106 ref. Bureau of Reclamation Contract 6-CS-30-04360.

Descriptors: *Dam construction, *Archaeology, History, Water resources development, Arizona, Social aspects.

In June 1986, the Bureau of Reclamation awarded a three-year contract for historical archaeological studies as part of the mitigation program for the Regulatory Storage Division (Plan 6) of the Central Arizona Project. This study focuses on reconstructing the social history of the workers and their families who lived in several temporary dam construction camps dating from the 1890s to 1940s. The first chapter discusses experience in managing the study during the second year of the project and outlines plans for the third and final year. Chapters 2 and 3 present the results of supplemental archaeological survey at the northern end of the New Waddell Dam locale. Chapter 2 describes homestead and ranch sites, and Chapter 3 discusses the Humbug Creek hydraulic mining complex. Chapters 4, 5, and 6 present historical, sociological and archaeological perspectives, respectively, of the Roosevelt Dam construction community. (Author's abstract)
W90-00149

INVESTIGATION OF ARCHAIC SUBSISTENCE AND SETTLEMENT IN THE HARQUAHALA VALLEY, MARICOPA COUNTY, ARIZONA.
Northland Research, Inc., Flagstaff, AZ.
T. W. Bostwick, O. K. Davis, P. C. Hatch, J. Hutira, and S. M. Lewenstein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-164842. Price codes: A19 in paper copy, A01 in microfiche. 1988. 422p, 95 fig, 99 tab, 208 ref, 5 append. Bureau of Reclamation Contract 3-PA-30-00740.

Descriptors: *Irrigation canals, *Archaeology, *Arizona, Flood control, Harquahala Valley, History, Water resources development.

Eight archaeological sites were investigated within the new right-of-way for a distribution canal and flood control structure to serve the Harquahala Valley Irrigation and Drainage District. The majority of the materials in these sites, all of which were mostly surface phenomena, appears to date to the Archaic stage, which is a poorly understood time in the prehistoric record of the Southwest. Analysis of data recovered suggests that these sites were campsites used during seasonal exploitation of local resources over a long period of time, perhaps spanning most of the Archaic stage, and also some of the succeeding Formative stage. (Author's abstract)
W90-00150

SIDE EFFECTS OF WATER RESOURCES MANAGEMENT.
International Association of Hydrological Sciences Publication No. 172, 1988. 269p. Edited by A. Volker and J.C. Henry.

Descriptors: *Water resources management, *Environmental effects, Water management, Case studies, Groundwater management, Surface water.

The present publication deals with the side effects of water resources management, which are defined as effects beyond the objectives of the project. The present publication deals mainly with those side effects which are generally considered as negative. The interest is evident: a project may fail because the objective is not achieved but many projects also fail because of the magnitude of the harmful side effects generated by the project. Because of the extensiveness of the subject and the many disciplines involved it was not possible to completely cover the subject. The information which became available partially dealt with general aspects of a certain side effect and partially with concrete situations containing valuable experience. It is the first objective of this publication to make this experience, which so far has not been published, available to a wide audience. The second objective is to show the role of side effects, and especially the negative side effects, in the development of the science of water resources engineering. Apart from Chapter 1 which deals with general aspects of water resources management and side effects, the present publication is divided into two main themes: side effects related to surface water management (Chapters 2 and 3) and side effects resulting from groundwater management (Chapters 4 and 5). Within each theme a distinction is made between 'overviews' and 'case studies'. The overviews present general information on different categories of side effects. The two chapters devoted to case studies contain information on practical experience in the field under consideration. Certain of these studies cover topics mentioned in the overviews. (Lantz-PTT)
W90-00160

CHARACTERISTICS OF GREENTREE RESERVOIRS: A SURVEY OF MANAGERS.
Arkansas Univ. at Monticello. Dept. of Forest Resources.
T. B. Wigley, and T. H. Filer.
Wildlife Society Bulletin WLSBA6, Vol. 17, No. 2, p 136-142, Summer 1989. 2 tab, 22 ref.

Descriptors: *Wetlands, *Wildlife management, *Waterfowl, *Hunting, Ducks, Trees, Greentree reservoirs, Flooding.

Wildlife managers sometimes seasonally flood living hardwood timber to provide waterfowl habitats. Little data are available describing practices used by managers and characteristics of these greentree reservoirs (GTR). A survey of managers was undertaken to determine characteristics of GTR's, management practices, waterfowl and hunting uses, and problems. Management of GTR's was primarily confined to the southeastern U.S. Most were <100 ha, <25 years old, and located on clay or silt loam soil. The timber stand was usually uneven-aged and dominated by oak or oak associations. Timber harvesting was not common. Typically, flooding occurred annually from late October through mid-March. Few managers, however, were able to adhere to this schedule because of beavers and natural flooding. The water source was most often a river or runoff from rainfall or irrigated farmland. Mallards and wood ducks were the dominant waterfowl species using GTR's. Typical GTR's annually provided <100 days of hunting and a harvest of <100 waterfowl. The most common problems reported by managers were poor regeneration of timber and loss of trees through mortality, wind-throw, or crown dieback. Reports of tree mortality and other problems were often more common in GTR's >20 years old, in GTR's with timber >60 years old, and in GTR's where draining was delayed in >2 of 10 consecutive years. Managers generally perceived that acorn production and growth in tree diameter were similar in GTR's and naturally flooded stands. Despite problems, most managers planned to continue using GTR's and many anticipated developing additional GTR's. (Author's abstract)
W90-00399

ROLE OF THE MISSISSIPPI RIVER IN WETLAND LOSS IN SOUTHEASTERN LOUISIANA, U.S.A.
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
R. H. Kesel.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 3, p 183-193, May-June

1989. 8 fig, 6 tab, 34 ref. DOI MMS contract 14-12-0001-30252.

Descriptors: *Sediment discharge, *Suspended load, *Wetlands, *Dam effects, *Levees, *Louisiana, *Mississippi River, Sediment transport, Reservoirs.

The historic evidence of the magnitude of change in the suspended sediment discharge of the Lower Mississippi River is examined. These data provide a basis for estimating the amount and importance of overbank sediment contributions to the wetlands both historically and for possible future use. The suspended load of the Lower Mississippi River has decreased almost 80% since 1950. The long-term suspended sediment record can be loosely subdivided into three phases: (1) historic interval prior to 1900, (2) predam period from 1930 to 1952, and (3) postdam period from 1963 to 1982. The suspended load decreased 43% from the historic to the predam period and 51% from the predam to the postdam period. The decreases in suspended load after 1952 concide with the construction of reservoirs and dams on the Missouri and Arkansas rivers. Earlier decreases may be the result of changes in land use measurement practices. The decrease in suspended load and the elimination of overbank flow by the construction of artificial levees are considered to be the major causes of coastal wetland loss in southeastern Louisiana. During the historic period, sediment accumulation of the marsh surface was greater than the rate of water level rise. During the pre and postdam periods, the rate of water level rise exceeded sediment accretion on the marsh surface. Although the elimination of overbank sediment clearly exacerbated the wetlands loss, an accelerated rate of water level rise during the past 25 years has been a dominant factor. Based on estimates of available overbank sediment, it is suggested that the most viable management strategy for the wetlands would be the diversion of sediment into selected areas where the land loss is most critical. (Author's abstract)
W90-00446

CONFLICT, CONTROVERSY, AND COMPROMISE: THE CONCHO WATER SNAKE (NERODIA HARTERI PAUCIMACULATA) VERSUS THE STACY DAM AND RESERVOIR.
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
A. E. Mathews.
Environmental Management EMNGDC, Vol. 13, No. 3, p 297-307, May-June 1989. 1 fig, 1 tab, 22 ref.

Descriptors: *Dam construction, *Reservoir construction, *Dam effects, *Stacy Dam, *Stacy Reservoir, *Texas, Water snakes, Dam design, Environmental protection.

The Colorado River Municipal Water District (CRMWD) of Big Spring, Texas, planned to construct the Stacy Reservoir and Dam on the Colorado River near Paint Rock, Texas, yet needed a Section 404 permit from the US Army Corps of Engineers pursuant to the Clean Water Act. In 1986, the Concho water snake was listed as threatened under the Endangered Species Act (ESA). Much of its remaining range included the stretch of the Colorado River that would be flooded by the proposed dam. After initially rejecting CRMWD proposals for mitigation, and informing the Corps of Engineers that it would issue a jeopardy opinion regarding the 404 permit pursuant to Section 7 of the ESA, the US Fish and Wildlife Service (FWS) reversed its stand. The final biological opinion stated that reasonable and prudent alternatives previously rejected as unfeasible would remove the threat of jeopardy. It is concluded that experimental management techniques proposed by FWS to allow dam construction do not adequately ensure survival of the Concho water snake and an alternative water source should have been found. (Author's abstract)
W90-00454

SIMULATING THE EFFECTS OF GLEN CANYON DAM RELEASES ON GRAND CANYON RIVER TRIPS.
SWCA, Inc., Tucson, AZ.
R. E. Borkan, and A. H. Underhill.
Environmental Management EMNGDC, Vol. 13, No. 3, p 347-354, May-June 1989. 12 ref.

Descriptors: *Flow pattern, *Recreation, *Grand Canyon River, *Dam effects, *Flow, Fluctuations, Simulation, Glen Canyon Dam, Environmental effects, Dam releases.

In the early 1980s, the Bureau of Reclamation and other federal agencies initiated research to determine the impacts Glen Canyon Dam releases have on downstream resources. The impact of flow fluctuations on recreational resources, specifically rafting through Grand Canyon National Park (GCNP), are discussed. The Lucas-Shechter wilderness use simulation model (WUSM), already adapted to Colorado River trips, was modified to simulate the effects of various of dam releases on white water river trips through GCNP. In evaluating flow alternatives, the rules are: (1) the higher the flow, the more time is available for attraction site visits, (2) the lower the flow, the greater number of parties delayed at rapids, and (3) the greater the number of parties launched, the greater the encounter rates. The WUSM has been shown to be an effective tool for evaluating the effects of alternative Glen Canyon Dam releases on Colorado River raft trips through Grand Canyon National Park. Any dam release scenario can now be tested on this model, and it will simulate the following effects of dam releases on river trips: (1) time available for attraction site visits, (2) delay at rapids due to low river flow, and (3) encounters with other parties. It was unable to simulate the human dimensions of river trips, including the frustration of waiting for higher water, the thrill of a rapid ride, the congeniality of a group, an elegant dinner on a beach in the Grand Canyon, or making new friends. Whether the model could successfully test alternative flow regimes was also accomplished. This modification of the Lucas-Shechter WUSM has shown that this computer simulation model can be a very useful tool to Grand Canyon river managers and Glen Canyon Dam operators. Computer models, such as the WUSM, provide for evaluation of alternative management options prior to implementation. In this case, the WUSM has successfully evaluated some of the impacts of fluctuating Glen Canyon Dam releases on Grand Canyon river trips. (Miller-PTT)
W90-00457

EFFECTS OF REGULATION ON THE ECOLOGY OF THE LITTORAL ZONE AND THE FEEDING OF WHITEFISH, COREGONUS SPP., IN LAKES IN NORTHERN FINLAND.
Valtion Teknillinen Tutkimuskeskus, Oulu (Finland). Building Lab.
For primary bibliographic entry see Field 2H.
W90-00612

MODELLING THE IMPACTS OF LAKE REGULATION ON WHITEFISH STOCKS.
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W90-00613

7. RESOURCES DATA

7A. Network Design

DESIGN AND IMPLEMENTATION OF A LARGE-SCALE NATURAL-GRADIENT TRACER TEST.
Geological Survey, Boston, MA.
For primary bibliographic entry see Field 5B.
W90-00029

FIELD ASSESSMENT OF THE EFFECTS OF CONTAMINANTS ON FISHES.
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5C.
W90-00083

NEED FOR CLIMATIC AND HYDROLOGIC DATA IN AGRICULTURE IN SOUTHEAST ASIA.
Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. 310p. Compiled by E.A. Fitzpatrick and J.D. Kalma.

Descriptors: *Data collections, *Water resources data, *Climatology, *Research priorities, *Data acquisition, *Hydrologic data, *Agricultural hydrology, Hydrologic budget, Model studies, Crop production, Hydrologic data collections, Training.

This Technical Memorandum contains the proceedings of a United Nations University sponsored Workshop on the need for extending and improving the use of climatic and hydrologic data for the benefit of agriculture in Southeast Asian countries. The Workshop was held in December 1983 in Canberra. These proceedings comprise the full text of 24 papers and abstracts of another two. The 26 papers were arranged in six sessions with the following themes: recognition of basic problems and the need for data; new approaches to the application of climatic and hydrologic data--the need for training; methods for extending the utility of climatic and hydrologic data; assessment of climatic or hydrologic hazards in agricultural production; application of various water balance and crop growth/development models which draw on climatic and hydrologic data; and availability, quality and accessibility of data for agriculture applications. These proceedings also include a report on plenary discussions following the presentation of papers in each session and an overview of group discussions on the final day of the Workshop. Each group considered the following major aspects: potential applications of data and their benefit to the countries of Southeast Asia; type and quality of the data needed; the facilities needed for efficient provision and analysis of data; and educational and training needs. (See W90-00101 thru W90-00122) (Author's abstract)
W90-00100

REQUIREMENTS FOR AND USE OF A FLOOD AND AGRO-ECONOMIC DATA BASE.
Willing and Partners, Canberra (Australia).
A. P. Aitken, and A. R. Moodie.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 141-145, 9 ref.

Descriptors: *Data interpretation, *Data collections, *Water resources data, *Data acquisition, *Floods, *Hydrologic data, *Agricultural hydrology, *Economic aspects, Data collections, Crop yield, Flood control.

In a recent paper, the effect of the probabilistic nature of catchment yield on the resulting distribution of the estimated present worth of benefits, from an irrigated agricultural project in Central Java, Indonesia, was explored. The sensitivity of the estimated benefits to the choice of benefit function was also tested. This paper concentrates on the flood and agro-economic data requirements for agricultural projects, and the application of these data in modern techniques of economic analysis which include consideration of the distribution of the present worth of benefits. To successfully utilize the modern probability methods of economic analysis, or even the traditional methods, requires a considerable volume of agro-economic data which generally does not appear to be available in developing countries. The data requirements for an in-depth assessment of the benefits of flood mitigation works including a description of the distribution of the present worth of the benefits includes: yield loss due to flooding magnitude and duration, yield loss due to time of occurrence of flooding, and farmers response to flood mitigation works. It was concluded that these techniques, which are receiving some application in developed

countries, could also be applied in the Southeast Asian region. (See also W90-00100) (Lantz-PTT)
W90-00111

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE--A PROTOTYPE FOR NATIONWIDE IMPLEMENTATION.
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine, M. E. Moss, J. A. Smath, and W. O. Thomas.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2244, 1984. 39p, 15 fig, 17 tab, 23 ref, append.

Descriptors: *Cost analysis, *Network design, *Data acquisition, *Stream gages, *Maine, Economic aspects, Costs, Streamflow.

Data uses and funding sources of the stream gaging program in Maine were identified for the 51 continuous stream gages currently being operated with a budget of $211,000. Three stream gages were identified as producing data no longer sufficiently needed to warrant continuing their operation. Data collected at three other stations were identified as having other uses specific only to short-term studies; it is recommended that these stations be discontinued at the end of the data collection phases of the studies. The remaining 45 stations should be maintained in the program. The current policy for operation of the 45 station program would require a budget of $180,300 per year. The average standard error of estimation of streamflow records is 17.7%. This level of accuracy could be maintained with a budget of approximately $170,000 if resources were redistributed among the gages. A minimum budget of $155,000 is required to operate the 45-gage program; a smaller budget would not permit proper service and maintenance of the gages and recorders. At the minimum budget, the average standard error is 25.1%. Large parts of Maine's interior were identified as having sparse streamflow data. It was determined that this sparsity be remedied as funds become available. (Author's abstract)
W90-00195

WATER-QUALITY DATA-COLLECTION ACTIVITIES IN COLORADO AND OHIO: PHASE I--INVENTORY AND EVALUATION OF 1984 PROGRAMS AND COSTS.
Geological Survey, Columbus, OH.
J. Hren, T. H. Chaney, J. M. Norris, and C. J. Oblinger-Childress.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2295-A, 1987. Chapter A. 71p, 13 fig, 21 tab, 7 ref.

Descriptors: *Water resources data, *Water quality, *Data acquisition, *Colorado, *Ohio, *Costs, Economic aspects, Project planning.

The U.S. Geological Survey has undertaken a pilot study in Colorado and Ohio to: (1) determine the characteristics of current water quality data collection activities of Federal, State, and local agencies, and universities; and (2) determine how well the data from these activities can be used to improve the ability to answer major broad-scope questions. Most samples from both States were from surface water sources. Groundwater samples represented only 9% of the samples reported from Colorado and 4% of those from Ohio. Identified organizations collected water quality data in response to various mandates and for various purposes, which are summarized into three general categories: (1) to meet permit requirements; (2) to fulfill compliance and enforcement needs; and (3) to characterize ambient water quality conditions. Of about one-third million samples reported for Colorado and nearly 1.2 million samples reported for Ohio during 1984, only a fraction met all the required screening criteria. Although comparative laboratory costs were estimated, determination of total costs for the water quality data collections in the two States proved to be impossible within the scope of this study. Reliable, consistent estimates of total program costs would require detailed knowledge of the different appropriations, cost allocations, and accounting practices of each agency which operates data collection programs. (Peters-PTT)
W90-00208

ANALYSIS OF SURFACE-WATER DATA NETWORK IN KANSAS FOR EFFECTIVENESS IN PROVIDING REGIONAL STREAMFLOW INFORMATION.
Geological Survey, Lawrence, KS. Water Resources Div.
K. D. Medina.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2303, 1987. 28p, 11 fig, 5 tab, 8 ref.

Descriptors: *Network design, *Kansas, *Data acquisition, *Surface water, *Networks, *Streamflow, Flow profiles, Sampling, Regression analysis, Gaging stations, Network design, Statistical analysis.

This report documents the results of a generalized least squares regression analysis of the surface water data network in Kansas for its effectiveness in providing regional streamflow information. The correlation and time-sampling error of the streamflow characteristic are considered in the generalized least squares method. Unregulated medium-, low-, and high-flow characteristics were selected to be representative of the regional information that can be obtained from streamflow-gaging-station records for use in evaluating the effectiveness of continuing the present network stations, discontinuing some stations, and (or) adding new stations. The State was divided into three network areas, western, northeastern, and southeastern Kansas, and analysis was made for the three streamflow characteristics in each area, using three planning horizons. The analysis showed that the maximum reduction of sampling mean-square error for each cost level could be obtained by adding new stations and discontinuing some current network stations. Large reductions in sampling mean-square error for low flow information could be achieved in all three network areas, the reduction in western Kansas being the most dramatic. The addition of new stations would be most beneficial for mean-flow information in western Kansas. The reduction of sampling mean-square error for high flow information would benefit most from the addition of new stations in western Kansas. Southeastern Kansas showed the smallest error reduction in high flow information. A comparison among all three network areas indicated that funding resources could be most effectively used by discontinuing more stations in northeastern and southeastern Kansas and establishing more new stations in western Kansas. (Lantz-PTT)
W90-00213

EVALUATION OF PRECIPITATION CHEMISTRY SITING CRITERIA USING PAIRED STATIONS FROM NORTHERN MAIN AND SOUTHEASTERN TEXAS.
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
R. S. Artz, and G. D. Rolph.
Atmospheric Environment ATENBP, Vol. 23, No. 5, p 1033-1050, May 1989. 7 fig, 12 tab, 12 ref.

Descriptors: *Network design, *Acid rain, *Precipitation, *Atmospheric water, *Water chemistry, *Air pollution, Sampling, Ions, Path of pollutants, Statistical analysis.

Two-year precipitation chemistry data records from each of the two paired stations are compared to determine whether the precipitation chemistry is different. In each pair, one of the stations (Caribou, Maine and Victoria, Texas) violates National Atmospheric Deposition Program (NADP) siting requirements, while the other station (Presque Isle, Main and Beeville, Texas) is in compliance. Methods employed to carry out this study include the calculation of precipitation weighted statistics, the study of logarithmic distributions, the study of regression line residuals, the study of relative sample differences and the use of the no-parametric Wilcoxon test for two matched samples. Results indicate no clear differences occurred between paired stations over a seasonal or longer period of time; however, considerable variation was observed on a weekly basis. Maine stations were in excellent agreement for all ions: Texas stations showed small differences between ions typically associated with soil dust and between ions typically associated with anthropogenic activity. (Author's abstract)
W90-00347

UTILITY OF CLIMATIC STATION DATA IN MAKING HOURLY POTENTIAL EVAPOTRANSPIRATION ESTIMATES FOR REMOTE SENSING STUDIES.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2D.
W90-00357

INFORMATION REQUIREMENTS OF INTEGRATED ENVIRONMENTAL POLICY EXPERIENCES IN THE NETHERLANDS.
Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
A. Adriaanse, and R. Jeltes.
Environmental Management EMNGDC, Vol. 13, No. 3, p 309-315, May-June 1989. 5 fig, 2 tab, 3 ref.

Descriptors: *Water law, *Environmental policy, *The Netherlands, *Management planning, Information transfer.

During the last few years in the Netherlands, an integrated environmental policy has been developed. Solving environmental problems by means of effective and efficient solutions requires that the entire environmental cycle be considered in order to take all relevant compartments and aspects into account. Four different phases can de identified during the treatment of an environmental problem by management: (1) recognition, (2) formulation, (3) solution, (4) control. Some qualitative and quantitative aspects of the information demand of environmental policy in terms of information requirements. The process of information supply starts with an analysis of the demand. Subsequently, data from the environmental cycle have to be selected, aggregated, and presented adequately. Further, integrated environmental policy puts increased demands in the associative power of environmental systems. (Author's abstract)
W90-00455

SAMPLE SIZE REQUIREMENTS FOR ESTIMATION OF THROUGHFALL CHEMISTRY BENEATH A MIXED HARDWOOD FOREST.
Pennsylvania State Univ., University Park. School of Forest Resources.
K. M. Kostelnik, J. A. Lynch, J. W. Grimm, and E. S. Corbett.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 274-280, Jul-Sep 1989. 2 fig, 6 tab, 33 ref. NOAA, U.S. Dept. of Commerce Contract NA84-WC-C-06107.

Descriptors: *Data acquisition, *Sampling, *Rainfall, *Throughfall, *Forests, *Pennsylvania, *Chemistry of precipitation, Distribution, Hydrogen ion concentration, Nitrates, Potassium, Magnesium, Ions.

Six rainfall events were intensively sampled below a mixed hardwood forest canopy in central Pennsylvania to determine sample size requirements for estimation of throughfall volumes and ionic concentrations. Evaluation of the ionic parameters of throughfall revealed that the concentrations of most major ions were non-normally distributed. Differences in the distributions of concentrations were found to occur between ions as well as between storms. Significant departures from normality were mainly due to right-skewness. Only H+ exhibited a left skewed sample distribution. None of the basic transformations were effective in normalizing all parameters. A high degree of spatial variability was observed for each of the chemical

parameters. Nitrate and hydrogen ions (NO3(-) and H+), were found to be the least variable, whereas vegetatively mobile ions such as K+ and Mg(2+) exhibited the greatest variability. Because of the high event-to-event variation in the distributions of ion concentrations, specific sample-size requirements should be estimated for each ion through preliminary sampling of throughfall precipitation from several storms. (Author's abstract)
W90-00565

DETECTABILITY OF STEP TRENDS IN THE RATE OF ATMOSPHERIC SULPHATE DEPOSITION.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-00801

OPTIMIZATION APPROACH FOR GROUNDWATER QUALITY MONITORING NETWORK DESIGN.
California Univ., Santa Barbara. Dept. of Biological Sciences.
H. A. Loaiciga.
Water Resources Research WRERAQ, Vol. 25, No. 8, p 1771-1782, August 1989. 7 fig, 1 tab, 35 ref.

Descriptors: *Path of pollutants, *Monitoring, *Network design, *Groundwater quality, *Optimization, Water sampling, Sampling, Water quality management.

The optimal sampling plan for groundwater quality monitoring is formulated as a mixed integer programming (MIP) problem. A sampling plan consists of the number and locations of sampling sites as well as the temporal sampling frequency. The MIP network problem is defined by the minimization of the variance of estimation error subject to resource and unbiasedness constraints. The mean and covariance of the spatial/temporal variable (chloride concentration measurements) are derived from the advection-dispersion equation governing mass transport. The solution for the optimal sampling proceeds in two stages: (1) parameter estimation and (2) network optimization. The MIP model was successfully tested with a network design problem in a buried valley aquifer in Butler County, Ohio. The application illustrates the role of objective function, resource constraint, mass transport processes, and hydrogeologic setting in groundwater quality monitoring network design. (Author's abstract)
W90-00943

MEASURED AND SIMULATED WATER RELATIONS IN A DOUGLAS-FIR FOREST DURING THE DEVELOPMENT OF DROUGHT IN THE APENNINES, CENTRAL ITALY.
Centro di Studio per la Genesi Classificazione e Cartografia del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2A.
W90-00958

7B. Data Acquisition

SIMPLE MODEL FOR ASSESSING ANNUAL SOIL EROSION ON HILLSLOPES.
Silsoe Coll. (England).
For primary bibliographic entry see Field 2J.
W90-00008

MODELS OF STATISTICAL DISTRIBUTIONS FOR NPSP CONCENTRATIONS.
Venice Univ. (Italy). Facolta di Chimica Industriale.
For primary bibliographic entry see Field 5B.
W90-00019

DEVELOPMENT, TESTING, AND APPLICATIONS OF NONPOINT SOURCE MODELS FOR EVALUATION OF PESTICIDES RISK TO THE ENVIRONMENT.
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5C.
W90-00020

FIELD DATA ACQUISITION SYSTEMS.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
L. F. Huggins.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 399-409, 6 ref.

Descriptors: *Water pollution control, *Data acquisition, *Field tests, *Nonpoint pollution sources, Data storage and retrieval, Automation, Computers, Data interpretation, Land use, Model studies, Watershed management, Gaging stations, Monitoring, Water quality control, Costs.

The lack of better quality hydrometeorologic and water quality data from various geographic regions is a primary impediment to more rapid progress in controlling nonpoint pollution sources (NPS). The scope and value of monitoring programs need to be broadened to meet the requirements for not only a range of water quality modelers, but concurrently for other disciplines. This can be accomplished at modest cost by increasing the number of parameters monitored and departing from the outdated mode of recording parameter levels at fixed time intervals. Micro-processor based data acquisition systems offer the opportunity to obtain expanded data bases at reasonable costs; however, this will only come to fruition by properly designing monitoring programs to take advantage of this technology. The selection of data acquisition equipment should be based on its flexibility and the opportunity to increase data base integrity, via communications to a central computer system, while simultaneously reducing field labor requirements. The range of parameters monitored must be increased and recording modes that take advantage of computer technology must be adopted. Three separate functional requirements should be incorporated into any NPS data management system: verification/editing, archival/retrieval and analysis/interpretation. In the trade-offs always involved between storage space and retrieval convenience, increasing emphasis needs to be given to efficient storage formats. Analysis requirements should be viewed independently from archival storage considerations. Field monitoring of nonpoint source pollution needs to be expanded for small, single land use areas to quantify benefits of individual treatment systems. In this manner, information vital to the continued development of improved models can be obtained. Watershed scale monitoring is useful for establishing general levels of pollution and for testing the accuracy of comprehensive models or for developing statistical models, but not for establishing cause-effect relationships or component relationships for deterministic models. Monitoring efforts must be long-term projects; the cost of establishing a gaging network and the year-to-year variability of storm induced data make 2-3 year efforts poor investments. (See also W90-00001) (Lantz-PTT)
W90-00021

FIELD COMPARISON OF GROUND-WATER SAMPLING DEVICES FOR RECOVERY OF PURGEABLE ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ.
T. E. Imbrigiotta, J. Gibs, T. V. Fusillo, J. J. Hochreiter, and G. R. Kish.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p F3-F4.

Descriptors: *Samplers, *Measuring instruments, *Groundwater quality, *Organic compounds, *Water sampling, Pumps, Field tests, Comparison studies, Water quality control, Statistical analysis, Well water, Pollutant identification, Bailers.

The increasing need to sample groundwater for analysis for organic compounds has triggered the development and production of a wide variety of groundwater sampling devices. The seven samplers evaluated were: gear submersible pump, helical-rotor submersible pump, bladder pump, peristaltic pump, syringe sampler, open bailer, and point-source bailer. These sampling devices were tested in three wells of differing depth and varying combinations and concentrations of purgeable organic compounds. Fifteen to 28 replicate samples were collected at each well with each sampler and analyzed for all purgeable priority pollutants. The mean concentrations were compared statistically through analysis of variance testing to determine whether the sampling devices differed significantly, at the 95% confidence level, in their ability to recover each purgeable organic compound. Significant differences in sampler recovery concentrations were found for some purgeable organic compounds at each of the sites. The order of the samplers from most effective (highest) recovery to least effective (lowest) recovery varied among sites and among compounds detected at a site. A composite ranking of the sampling devices from highest to lowest recovery based on data from all three sites yielded the following order: (1) point-source bailer; (2) gear submersible pump; (3) open bailer; (4) bladder pump; (5) helical-rotor submersible pump; (6) peristaltic pump; and (7) syringe sampler. (See also W90-00022) (Lantz-PTT)
W90-00047

RECENT DEVELOPMENTS IN DOWNHOLE SAMPLERS FOR ORGANIC AND VOLATILE COMPOUNDS IN GROUND WATER.
Geological Survey, Stennis Space Center, MS.
J. H. Ficken, W. H. Sonntag, and A. J. Boettcher.
IN: U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985. USGS Open-File Report 86-481, 1988. p F5-F8, 3 fig.

Descriptors: *Water sampling, *Samplers, *Measuring instruments, *Organic compounds, *Groundwater quality, *Volatile organic compounds, *Sample preservation, Prototypes, Water quality control, Pumps.

The need for the development of downhole water samplers to collect groundwater samples that are not contaminated or diluted is being addressed by the US Geological Survey in several areas of application. In response to requests by investigators for samplers having specialized characteristics and functions unavailable commercially, three sampler designs were developed and prototypes built to satisfy requirements of specific sampling endeavors. First, a pump-type sampler of stainless steel, which has a large-diameter (about 2 in) and a small-diameter (1-1/4 in) version. This sampler is lowered to the desired depth, and the logging tool is activated. This causes a reciprocating action that operates a piston to pump water up through a sample cylinder or reservoir attached below the pump. After four or five cycles, the pump is stopped in a position that seals the sample reservoir. The sampler is then brought to the surface, shutoff valves are closed, and the sample reservoir is removed. The sample reservoir then can be shipped directly to the laboratory, without the transferral of the water sample to another container. Second, a flow-through sampler, was developed in response to the need for a sampler of small diameter that minimizes contact of oxygen with the sampled water. To obtain a water sample, the sampler is lowered 'open' to the desired depth. The well is then pumped by a submersible pump positioned above the sampler or a conventional pump at the surface. This allows water to flow through the sampler. The sampler is closed when the logging head is activated. Samples are extracted at the surface with a syringe and needle inserted through a septum in the wall of the cylinder. The third type of sampler was developed in response to the needs of the Toxic Waste Program for a sampler to go down a 2-in well to depths of 200 ft and collect a sealed sample. (See also W90-00022) (Lantz-PTT)
W90-00048

USE OF DETRENDED CORRESPONDENCE ANALYSIS TO IDENTIFY FACTORS THAT

AFFECT THE STRUCTURE OF AQUATIC COMMUNITIES.
Geological Survey, Menlo Park, CA. Water Resources Div.
H. V. Leland, and J. L. Carter.
IN: Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984. USGS Open-File Report 324, 1987. p 75-78, 19 ref.

Descriptors: *Data interpretation, *Aquatic life, *Statistical analysis, *Ecosystems, *Aquatic environment, Monitoring, Detrended correspondence analysis.

Detrended correspondence analysis is an ordination method that is effective for analyzing biological monitoring data. The method is evaluated for its usefulness in defining relationships among samples and species where an environmental gradient of copper was imposed. The method is also useful in identifying major factors that control the spatial distribution of periphyton and benthic macroinvertebrates. The method is highly sensitive to differences among samples. (See also W90-00052) (Author's abstract)
W90-00057

STATISTICAL RAIN ATTENUATION PREDICTION MODEL WITH APPLICATION TO THE ADVANCED COMMUNICATION TECHNOLOGY SATELLITE PROJECT. I--THEORETICAL DEVELOPMENT AND APPLICATION TO YEARLY PREDICTIONS FOR SELECTED CITIES IN THE UNITED STATES.
Analex Corp., Cleveland, OH.
For primary bibliographic entry see Field 2B.
W90-00094

MINIMUM DATA SETS: HYDROLOGICAL APPLICATIONS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 3F.
W90-00103

SIMULATION MODEL FOR MULTIPLE CROPS IN A RAINFED RICE-BASED CROPPING SYSTEM.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2B.
W90-00116

COLLECTION, QUALITY AND ACCESSIBILITY OF CLIMATIC AND HYDROLOGIC DATA USED IN AGRICULTURAL APPLICATIONS IN NEW ZEALAND.
Meteorological Service, Christchurch (New Zealand).
A. I. Tomlinson.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 251-259, 2 fig, 12 ref.

Descriptors: *Data collections, *Water resources data, *Hydrologic data collections, *Climatic data, *Agricultural hydrology, *New Zealand, *Databases, River flow, Groundwater quality, Rainfall, Information exchange, Data acquisition.

In New Zealand, the collection and archiving of climatic and hydrologic data is shared between two government agencies. The Meteorological Service maintains the country's official climatic data archive and the Water and Soil Division of the Ministry of Works and Development (MWD) maintains the hydrologic data archive. Both archives have been completely computer based for 10 years and were partially so for 10 years prior to that. The climatic data base is structured by station and by item. Most files are of daily climatic data but some are of synoptic data at 6, 3 or 1 hour intervals. Daily climatological information generally goes back to the beginning of the record, the earliest of which is 1852. Currently, a network of 370 climatological stations and 1500 rainfall stations are operated in New Zealand. The hydrologic data base consists of river flow data (series of water levels, rating tables and channel cross sections), groundwater data (levels and water quality) and rainfall data (recording and daily). Currently flow data is collected from over 800 sites with records from a further 400 closed sites. Groundwater data is collected from about 200 sites. Data in both archives undergoes manual and automated editing. Both the Meteorological Service, and the MWD publish lists of data available for general use. Numerous publications of data in a fairly unprocessed form are available. (See also W90-00100) (Lantz-PTT)
W90-00120

ASPECTS OF HYDROMETEOROLOGICAL DATA, MEASUREMENT, ANALYSIS AND APPLICATION.
University of New England, Armidale (Australia). Faculty of Resource Management.
For primary bibliographic entry see Field 2B.
W90-00122

ESTIMATION OF RECHARGE RATES TO THE SAND AND GRAVEL AQUIFER USING ENVIRONMENTAL TRITIUM, NANTUCKET ISLAND, MASSACHUSETTS.
For primary bibliographic entry see Field 2F.
W90-00210

LABORATORY DATA ON COARSE-SEDIMENT TRANSPORT FOR BEDLOAD-SAMPLER CALIBRATIONS.
Geological Survey, Vancouver, WA. Water Resources Div.
D. W. Hubbell, H. H. Stevens, J. V. Skinner, and J. P. Beverage.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2299, 1987. 31p, 30 fig, 8 tab, 6 ref.

Descriptors: *Data acquisition, *Laboratory methods, *Sediment transport, *Bed load, *Sampling, Sedimentology, Particle size, Data collections, Streambeds.

A unique facility capable of recirculating and continuously measuring the transport rates of sediment particles ranging in size from about 1 to 75 millimeters in diameter was designed and used in an extensive program involving the calibration of bedload samplers. The facility consisted of a 9-foot-wide by 6-foot-deep by 272-foot-long rectangular channel that incorporated seven automated collection pans and a sediment-return system. The collection pans accumulated, weighed, and periodically dumped bedload falling through a slot in the channel floor. Variations of the Helley-Smith bedload sampler, an Arnhem sampler, and two VUV-type samplers were used to obtain transport rates for comparison with rates measured at the bedload slot (trap). Tests were conducted under 20 different hydraulic and sedimentologic conditions (runs) with 3 uniform-size bed materials and a bed-material mixture. Hydraulic and sedimentologic data collected concurrently with the calibration measurements are described and, in part, summarized in tabular and graphic form. Tables indicate the extent of the data, which are available on magnetic media. The information includes sediment transport rates; particle size distributions; water discharges, depths, and slopes; longitudinal profiles of streambed surface elevations; and temporal records of streambed-surface elevations at fixed locations. (Author's abstract)
W90-00211

SPECIFIC CONDUCTANCE: THEORETICAL CONSIDERATIONS AND APPLICATION TO ANALYTICAL QUALITY CONTROL.
R. L. Miller, W. L. Bradford, and N. E. Peters.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2311, 1988. 16p, 5 fig, 10 tab, 30 ref.

Descriptors: *Water quality, *Water analysis, *Specific conductivity, *Quality control, *Mathematical analysis, Theoretical analysis, Chemical analysis, Hydrogen ion concentration.

Several theoretical aspects and practical applications of specific conductance to the study of natural waters are considered. A review of accepted measurements of conductivity of secondary standard 0.01 N KCl solution suggests that a widely used algorithm for predicting the temperature variation in conductivity is in error. A new algorithm is derived and compared with accepted measurements. Instrumental temperature compensation circuits based on 0.01 N KCl or NaCl are likely to give erroneous results in unusual or special waters, such as seawater, acid mine waters, and acid rain. An approach for predicting the specific conductance of a water sample from the analytically determined major ion composition is described and critically evaluated. The model predicts the specific conductance to within +or-8% (one standard deviation) in waters with specific conductances of 0 to 600 microSiemens/cm. Application of this approach to analytical quality control is discussed. (Author's abstract)
W90-00217

EXPERIENCES WITH TWO HOT WIRE INSTRUMENTS FOR MEASURING THE LIQUID WATER CONTENT IN CLOUDS.
Oak Ridge National Lab., TN. Information Research and Analysis Div.
H.-E. Hoffman, J. Demmel, and H. Loebel.
Available from the National Technical Information Service, Springfield, VA 22161, as N8829255. Price codes: A03 in paper copy, A01 in microfiche. Report No. ESA-TT-1085, June 1988. 42p, 17 fig, 19 ref.

Descriptors: *Hot wire hygrometers, *Hygrometery, *Cloud liquid water, *Measuring instruments, *Clouds, Performance evaluation, Temperature, Wind velocity.

The results of airborne measurements of liquid water contents using two hot wire instruments--the Johnson-Williams (J.-W.) and the CSIRO-King (C.-K.) instruments--are very consistent within the 0.04 to 0.46 g/cu m range, subject to correct dry-air calibration and to the exclusion of systematic errors. The dry-air values of the J.-W. instrument are not at all, or only slightly, affected by variations in airspeed, height and temperature, while those of the C.-K. instrument are markedly affected. Radio signals have a very noticeable influence on the C.-K. signals. In both instruments, atmospheric turbulence and banking maneuvers produce similar signals to those produced by the liquid water content. In the case of the C.-K. instrument, it is not possible to achieve sufficient accuracy in transferring wind tunnel calibration data to flight measurements. (Author's abstract)
W90-00244

TOXIC EFFECTS OF METALS ON FISH: EVALUATION OF PHYSIOLOGICAL TEST METHODS (TOXISKA EFFECKTER AV METALLER PA FISK: PROVNING AV FYSIOLOGISK TESTMETDIK).
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
For primary bibliographic entry see Field 5C.
W90-00271

MICRODETERMINATION OF TRACE COBALT IN WATER BY DIRECT POLYURETHANE FROM THIN-LAYER SPECTROPHOTOMETRY.
For primary bibliographic entry see Field 5A.
W90-00294

INDIRECT SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE IN WATER WITH

ZIRCONIUM-SPADNS BY FLOW INJECTION ANALYSIS.
Yarmouk Univ., Irbid (Jordon). Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W90-00295

RUBIDIUM DETERMINATION IN MINERAL AND THERMAL WATERS BY ATOMIC-ABSORPTION SPECTROMETRY.
P. Bermejo Barrera, A. Bermejo Barrera, C. Herrero Latorre, and F. Bermejo Martinez.
Analytical Letters ANALBP, Vol. 22, No. 6, p 1601-1608, June 1989. 1 fig, 2 tab, 7 ref.

Descriptors: *Water analysis, *Atomic absorption spectroscopy, *Rubidium radioisotopes, *Mineral water, *Thermal water, *Chemical analysis, Quantitative analysis, Reagents.

A new procedure for rubidium determination in mineral and thermal waters using flame atomic-absorption spectrometry is described. To suppress ionization interference potassium solution was added. Rubidium can be determined in presence of Ca, Mg, Sr, Li, Cs, Fe, Al, CO3(--), F(-) and S(--) at higher levels than levels of these elements in waters. The precision and accuracy of the method were also investigated. In 163 mineral and thermal waters analyzed, the rubidium concentration range is between 0.08 to 0.84 microgram per ml. (Author's abstract)
W90-00296

DETERMINATION OF NITRITE BY SINGLE-SWEEP POLAROGRAPHY.
Central China Normal Univ., Wuhan. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W90-00297

SEMIQUANTITATIVE AND QUANTITATIVE DETERMINATION OF TRACE AMOUNT OF PHOSPHATE ION IN WATER USING POLYURETHANE FOAM THIN-LAYER COLORIMETRY.
Mansoura Univ. (Egypt). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W90-00298

SIMULTANEOUS EXTRACTION AND ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF 1B GROUP ELEMENTS (CU, AG, AU) FROM AQUEOUS THIOCYANATE/2,2-DIPYRIDYL-2-PYRIDYLHYDRAZONE (DPPH) SOLUTIONS.
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
J. A. Stratis, D. G. Themelis, D. G. Zatkas, and I. A. Kafritsas.
Analytical Letters ANALBP, Vol. 22, No. 7, p 1779-1790, 1989. 6 fig, 3 tab, 12 ref.

Descriptors: *Water analysis, *Pollutant identification, *Chemical analysis, *Atomic absorption spectroscopy, *Silver, *Gold, *Copper, *Separation techniques, Thiocyanates, Heavy metals, Quantitative analysis.

A system for simultaneous extraction of the cations of 1B Group elements, Cu-Ag-Au was studied in order to apply a simple analytical procedure for their determination by flame-AAS at low concentrations. Copper and gold gave colored complexes with DPPH, but silver did not. All of the studied metals could be extracted with the synergic effect of thiocyanate and DPPH in a wide pH range. The workable pH range for copper was 5.5-10.5. When the thiocyanate concentration was at least twice that of copper and the DPPH concentration ten times greater. Silver could be extracted from solutions acidified by hydrochloric acid and thiocyanate ions helped silver extraction but the effect of DPPH on this extraction system was not significant. Silver could be extracted in small quantities when only DPPH was present (pH > 8.0). Silver could be extracted only in small quantities also in the presence of thiocyanate at pH 4.0 and above, but it was extracted in a significant percentage when both DPPH and thiocyanate were in the solution of silver in the above pH range. Gold was extracted from solutions acidified by hydrochloric acid. It was also extracted as a complex with DPPH or thiocyanate in small quantities out in the presence of both of them gold was extract quantitatively in a wide pH range (4.0-9.0). The extraction system DPPH, thiocyanate/methyl isobutyl ketone could be applied for accurate determination of copper, silver and gold in low concentrations. (Mertz-PTT)
W90-00299

EXTRACTION, SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM WITH CAFFEIC ACID AND APPLICATION IN HIGH PURITY GRADE STEEL AND ENVIRONMENTAL SAMPLES.
Baroda Univ. (India). Dept. of Pharmacy.
N. Shah, S. K. Menon, M. N. Desai, and Y. K. Agrawal.
Analytical Letters ANALBP, Vol. 22, No. 7, p 1807-1817, 1989. 6 tab, 12 ref.

Descriptors: *Water analysis, *Chemical analysis, *Atomic absorption spectroscopy, *Spectrophotometry, *Molybdenum, *Pollutant identification, Heavy metals, Caffeic acid, Quantitative analysis, Separation techniques, Steel.

Caffeic acid was used as a complexing reagent for molybdenum. The yellow complex of Mo(6+) with caffeic acid was found to be extracted instantaneously into Aliquat 336. This can be used for the trace determination of molybdenum and for its separation from several other ions. The molar absorptivity of the complex was 110,000 L/mol/cm at 340 nm and the color system obeyed Beer's law in the range 0.04-0.99 ppm of Mo(6+). The molybdenum was also determined with atomic absorption spectrophotometry and the method was applied to steel, plant samples, and industrial effluents. (Mertz-PTT)
W90-00300

CALIBRATION OF FREQUENCY-DOMAIN ELECTROMAGNETIC INDUCTION METERS AND THEIR POSSIBLE USE IN RECHARGE STUDIES.
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Water Resources.
P. G. Cook, M. W. Hughes, G. R. Walker, and G. B. Allison.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 251-265, March 30 1989. 7 fig, 2 tab, 22 ref.

Descriptors: *Geophysical exploration, *Induction meters, *Calibrations, *Soil porosity, *Electromagnetic waves, *Soil physical properties, *Groundwater recharge, Model studies, Soil water.

Published models of soil conductivity are used to develop a calibration for frequency-domain electromagnetic induction meters. The calibration is portable, requiring only a knowledge of certain soil properties. One critical soil property is the impedance factor, a function of the soil water content. An impedance factor is selected from the literature which, when incorporated in the calibration, provides the best fit to measured apparent electrical conductivity. The calibration derived is used to test the ability of frequency-domain electromagnetic induction meters to estimate groundwater recharge rates in a semi-arid area of South Australia. Two analytical models relating total (or cumulative) recharge to soil solute profiles are used to derive theoretical relationships between electrical conductivity and total recharge. These modeled relationships provide a good fit to field data, suggesting that electromagnetic techniques have value in recharge studies. (Author's abstract)
W90-00365

FIELD TECHNIQUE FOR MEASURING WETLAND SOIL PARAMETERS.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 2H.
W90-00386

WETTABLE POROUS PLASTIC FOR USE AS A POROUS BARRIER IN SOIL HYDRAULIC STUDIES.
Ohio Agricultural Research and Development Center, Wooster. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W90-00389

FILTRATION STUDIED WITH ENDOSCOPES.
University Coll., London (England). Dept. of Civil and Municipal Engineering.
For primary bibliographic entry see Field 5F.
W90-00419

DENITRIFICATION IN A TRICKLING FILTER BIOFILM STUDIED BY A MICROSENSOR FOR OXYGEN AND NITROUS OXIDE.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 5D.
W90-00420

NOVEL METHOD FOR THE DETECTION AND SEMIQUANTITATIVE DETERMINATION OF TRACE LEVELS OF 2,4-D AND RELATED COMPOUNDS.
Aligarh Muslim Univ. (India). Dept. of Applied Chemistry.
For primary bibliographic entry see Field 5A.
W90-00424

SELECTIVE AND SENSITIVE SPECTROPHOTOMETRIC DETERMINATION OF COPPER IN WATER AFTER COLLECTION OF ITS BATHOCUPROINE COMPLEX ON AN ORGANIC-SOLVENT-SOLUBLE MEMBRANE FILTER.
Toyama Univ. (Japan). Faculty of Science.
For primary bibliographic entry see Field 5A.
W90-00428

QUANTITATIVE DETERMINATION OF VOLATILE ORGANOCHLORINE COMPOUNDS IN WATER BY GC - HEADSPACE ANALYSIS WITH DIBROMOETHANE AS AN INTERNAL STANDARD.
Leiden Rijksuniversiteit (Netherlands). Center for Chemistry and the Environment.
For primary bibliographic entry see Field 5A.
W90-00438

APPARATUS FOR THE IN-SITU DETERMINATION OF PHYSICO-CHEMICAL PARAMETERS ACROSS THE SEDIMENT-WATER INTERFACE.
ENEA, La Spezia (Italy). Centro Richerche Energia Ambiente.
G. Rossi, and C. Peroni.
Environmental Technology Letters ETLEDB, Vol. 10, No. 5, p 511-520, May 1989. 6 fig, 7 ref.

Descriptors: *Sampling, *Data acquisition, *Instrumentation, *Sediment-water interfaces, *Dissolved oxygen, *Hydrogen ion concentration, Conductance, Water temperature, Sedimentology, Hydrologic data collections.

An apparatus is described which allows in situ determinations of pH, Eh, dissolved oxygen and temperature at fixed depths (5 millimeter minimum intervals) both in sediments and the benthic boundary layer. The apparatus consists of a supporting framework and multiparametric probe actioned by a hydraulic piston. The apparatus was tested at three stations near La Spezia, Italy that were chosen for their different environmental and sediment characteristics. The results obtained with the apparatus agree with the different environmental characteristics of their sediments. (Geiger-PTT)
W90-00504

SEMI-MICRO C.O.D. DETERMINATION METHOD FOR HIGH-SALINITY WASTEWATER.
Santiago Univ. (Spain). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W90-00505

ACID DIGESTION FOR SEDIMENTS, SLUDGES, SOILS, AND SOLID WASTES. A PROPOSED ALTERNATIVE TO EPA SW 846 METHOD 3050.
California Dept. of Health Services, Los Angeles. Southern California Lab.
For primary bibliographic entry see Field 5A.
W90-00541

ANALYTICAL CHEMISTRY FOR ENVIRONMENTAL SCIENCES.
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5A.
W90-00542

HIGH-SENSITIVITY BATHYPHOTOMETER AND INVESTIGATIONS OF THE LIGHT FIELD OF LAKE BAIKAL.
Akademiya Nauk SSSR, Moscow. Inst. Yadernykh Issledovanii.
L. B. Bezrukov, N. M. Budnev, N. P. Butin, M. D. Gal'perin, and V. I. Dobrynin.
Oceanology ONLGAE, Vol. 28, No. 2, p 257-261, 1988. 3 fig, 5 ref.

Descriptors: *Measuring instruments, *Lake Baikal, *Bathyphotometry, *Photometry, *Deep water, *Aphotic zone, Quasistationary light fluxes, Photon emission, Remote control, Frequency distribution.

In order to make spectral measurements of weak quasistationary light fluxes in the water of Lake Baikal, a high-sensitivity bathyphotometer operating as a photon counter, equipped with a remote-controlled shutter was built. The photometer consists of an underwater unit, which is lowered by a three-strand geophysical cable, and an onboard station. The onboard station feeds DC power to the underwater unit, shapes and emits signals that move the shutter and change the light filters. On order from the onboard station, the count rate of single-photoelectron pulses by the FEU-130 photomultiplier is measured. Experimental data on the integral flux of photons resulting from spontaneous luminescence of the water of Lake Baikal and the vertical radiation attenuation index in the deep-water mode were obtained, and the frequency distribution of photons emitted by the water of the lake was found to follow the Poisson distribution. (White-Reimer-PTT)
W90-00550

SOURCES OF ERROR IN ANALYSIS OF MUNICIPAL SLUDGES AND SLUDGE-AMENDED SOILS FOR DI(2-ETHYLHEXYL) PHTHALATE.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. A. Eiceman, J. L. Gardea-Torresdey, G. A. O'Connor, and N. S. Urquhart.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 3, p 374-379, Jul-Sep 1989. 2 fig, 6 tab, 19 ref. USEPA Contract Cr-812687-02.

Descriptors: *Chemical analysis, *Sludge disposal, *Soil analysis, *Sludge, *Gas chromatography, *Mass spectrometry, *Phthalates, Error analysis, Standard deviation, Quantitative analysis, Soil amendments.

Rapid quantitative determination of di-(2-ethylhexyl) phthalate (DEHP) in municipal sludge is described for capillary gas chromatography/mass spectrometry (GC/MS) using selected ion monitoring with isotope dilution techniques. Propagation of error through a four-step technique is measured as an increase in variance with each additional step. Stepwise accumulated variation (as a percentage of total error) was GC/MS analysis with data reduction, 3%; analyst (sample preparation), 8%; heterogeneity of sludge, 30%; heterogeneity in sludge-amended soil, 77%; and error between planters, 100%. The relative standard deviation associated with analysis of sludge alone was 16% at 51 mg/kg DEHP concentration. The relative standard deviation for a 13 mg/kg DEHP loading in soil/sludge mixtures for a greenhouse study was 26.5%. Detection limits for DEHP in sludges with rapid screening procedures were fixed by interfering extractable matrices. The reliability of advanced GC/MS procedures for the determination of DEHP in sludge or sludge-amended soil is compromised by the heterogeneity of the original sludge supply. Even sludge grinding and careful mixing does not eliminate the problem. Sampling the sludge storage bin and mixing sludge with soil are far more significant sources of error in the final measurement than are the stages of sample preparation and instrumental analysis. (Author's abstract)
W90-00572

REVERSE WATER LEVEL FLUCTUATIONS IN SEMICONFINED AQUIFER SYSTEMS--'RHADE EFFECT'.
For primary bibliographic entry see Field 2F.
W90-00579

METHOD FOR EVALUATION OF ACIDIC SULFATE AND NITRATE IN PRECIPITATION.
Argonne National Lab., IL. Biological, Environmental, and Medical Research Div.
For primary bibliographic entry see Field 5A.
W90-00643

TESTING READSORPTION OF TRACE ELEMENTS DURING PARTIAL CHEMICAL EXTRACTIONS OF BOTTOM SEDIMENTS.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5A.
W90-00690

DETERMINATION OF THE ISOTOPIC COMPOSITION OF AMMONIUM-NITROGEN AT THE NATURAL ABUNDANCE LEVEL FROM ESTUARINE WATERS.
Delaware Univ., Lewes. Coll. of Marine Studies.
D. J. Velinsky, J. R. Pennock, J. H. Sharp, L. A. Cifuentes, and M. L. Fogel.
Marine Chemistry MRCHBD, Vol. 26, No. 4, p 351-361, July 1989. 2 fig, 3 tab, 23 ref. NSF Grant OCE-86-01616.

Descriptors: *Water analysis, *Sample preservation, *Isotope studies, *Nitrogen, *Ammonium, *Estuaries, *Chemical analysis, Distillation, Streams, Delaware River Estuary.

A method was developed to measure the stable nitrogen isotope ratio of dissolved ammonium, NH4(+), at the natural abundance level from estuarine waters. This method employed rapid stream distillation with collection of ammonium on zeolite via ion-exchange. The stream distillation step had a recovery of 103 +or-5%; subsequent exchange of the ammonium on zeolite had a yield of 96.4 plus or minus 1.6%. The zeolite with exchanged ammonium was converted to N2 in quartz tubes at 910 C with CuO and Cu and the isotopic composition of the gas was measured in an isotope ratio mass spectrometer. When analyzing 200 micrograms of nitrogen the accuracy using isotopic standards was within 4% of the true ratio, with an overall precision of plus or minus 0.5%. A benefit of this method is that samples can be distilled and preserved onboard ship, thereby minimizing storage artifacts. This method was used in a seasonal study of the isotopic composition of dissolved ammonium from the Delaware Estuary. (Author's abstract)
W90-00693

IONIC ALKYLLEAD COMPOUNDS IN ENVIRONMENTAL WATER AND SEDIMENTS.
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-00707

USE OF RADIONUCLIDES IN THE STUDY OF CONTAMINANT CYCLING PROCESSES.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
For primary bibliographic entry see Field 5A.
W90-00720

UNCERTAINTY IN DESCRIPTION OF SEDIMENT CHEMICAL COMPOSITION.
Istituto Italiano di Idrobiologia, Novara.
R. Baudo.
Hydrobiologia HYDRB8, Vol. 176/17, p 441-448, July 3, 1989. 9 fig, 3 tab, 13 ref.

Descriptors: *Chemical analysis, *Lake sediments, *Sediments, *Copper, *Sampling, *Chemical composition, *Mapping, Statistics.

The copper concentration in sediments of Lake Orta, Italy is used to illustrate: (1) the need for a large number of samples, and (2) the need for appropriate mapping techniques. The data fit a negative binomial distribution and the number of samples required to stay within specified limits of confidence ($P < 0.95$) increases from 6 to 412 when the relative standard deviation acceptable in the average os decreased from 100 to 10%. Five different maps have been produced by estimating 1154 points, derived from 57 data points. All provide mean values close to the one calculated from the original data, but in other respects they differ considerably. From these examples, it is evident that sampling and mapping spatially distributed variables must be carefully planned to give statistically significant portrayal of a target population. It is shown that the general distribution of sediment copper in Lake Orta can be approximated by a relatively small number of samples and that these may also characterize the lake-wide mean concentration. However, it is clear that where statistically significant dat are required, sampling densities increase greatly. Pragmatic considerations may well dictate that statistical significance is sought only where essential and that elsewhere a best approximation becomes acceptable. For this, the mathematical tools developed in geology (mostly for mining and exploration) seem appropriate and easily accessible now that computers are so widely used. All the calculations required are based on techniques described in books of statistics for geologists and adapted for use on a desk top computer. (Miller-PTT)
W90-00731

SEDIMENT SAMPLING EVALUATED WITH A NEW WEIGHTING FUNCTION AND INDEX OF RELIABILITY.
Uppsala Univ. (Sweden). Naturgeografiska Inst.
S. Floderus.
Hydrobiologia HYDRB8, Vol. 176/17, p 451-464, July 3, 1989. 9 fig, 10 ref.

Descriptors: *Sampling, *Sediment sampler, *Mapping, *Bottom sampling, *Spatial distribution, Variogram, Grab samplers.

A method for evaluating a record of irregular data, which may result from frequent synoptic grab-sampling, has been devised that produces a map of an interpolated spatial variable and estimates the areal mean and its reliability. Since a variogram could not be applied easily to this particular record of sedimentological data, an alternative method was developed and combined with a previous technique for choosing a reasonable sampling effort based on morphometric data. By this method, interpolation of the patchy data was obtained, using a distance weighted average, as well as an estimate of sediment quantity and the reliability of that estimate. The data are comparable despite surveys of varying completeness, regularity, intensity and choice of geographical area. The index of reliability is also a comprehensive rationale for a sampling strategy. Sediment maps have been presented, in

which the information level obtained, along with the interpolated sediment thickness and the original sampling points. Only thickness justified with respect to the information level are included in the maps. Tests have substantiated the validity of the approach. (Miller-PTT)
W90-00732

USE OF TURBIDIMETERS IN SUSPENDED SEDIMENT RESEARCH.
University Coll., Campbell (Australia). Dept. of Geography and Oceanography.
C. J. Gippel.
Hydrobiologia HYDRB8, Vol. 176/17, p 465-480, July 3, 1989. 5 fig, 4 tab, 40 ref.

Descriptors: *Suspended load, *Sediment load, *Suspended solids, *Turbidity, *Instrumentation, *Turbidimetry, Catchment areas, Water color, Hysteresis.

Some of the difficulties associated with turbidity measurement are highlighted and a preliminary sediment concentration versus turbidity relationship established for a small forested catchment near Eden (Australia) is presented. Australian streams are characterized by very fine suspended sediment. The normal 0.45 microm filter was found to allow a significant amount of sediment to pass. It is suggested that particle size distribution be the major consideration in selecting a filter pore size, rather than relying on the conventional (but nominal) separation between suspended and dissolved components of the load. This is particularly important in establishing a turbidity-suspended sediment concentration calibration since very fine particles can make a significant contribution to light scattering. Because of the very low suspended sediment concentration and high coloration of water (which interferes with absorption measurements of turbidity) in Geeburg Creek catchment, this area presents unusually difficult conditions under which to obtain meaningful turbidity data. The preliminary relationships established between turbidity and suspended sediment concentration are probably adequate for the purpose of estimating sediment concentration from turbidity. However, scatter in the dat suggest that detailed analysis of storm events could reveal hysteresis. The presence of hysteresis indicate changing sediment properties, and it is suggested that these variations could indicate changing source areas. (Miller-PTT)
W90-00733

SEDIMENT TRAP ASSEMBLAGES-A METHODOLOGICAL DESCRIPTION.
Uppsala Univ. (Sweden). Dept. of Hydrology.
L. Hakanson, S. Floderus, and M. Wallin.
Hydrobiologia HYDRB8, Vol. 176/17, p 481-490, July 3, 1989. 6 fig, 43 ref.

Descriptors: *Sampling, *Sediment transport, *Trapping, *Suspended sediments, *Sedimentation rates, Sediment traps, Model studies.

Sediment traps yield data on rates of sedimentation and provide a means of estimating redeposition and resuspension. Methods for distinguishing between primary and secondary material in the traps are surveyed and examples from trap development in the Swedish Sankt Anna Archipelago are used to formulate a model approach that is designed to yield data on the coastal flux of fine material. It is very difficult to separate net sedimentation from gross sedimentation and to precisely quantify resuspension. Broadly, there are three possible approaches which can produce an estimate of redeposition, which after consideration of the bottom dynamic conditions, may be used to estimate actual resuspension. Preliminary data from the Sankt Anna Archiepelago (a coastal area of south-eastern Sweden) was used to illustrate the influence of morphometry. This archipelago is 20 km wide with numerous islands which make it difficult to estimate the influence of wind velocity and fetch on rates of resuspension. Three assemblages of sediment traps were deployed for two periods in the summer of 1986. The sedimentation of secondary material, or redeposition, was estimated with the label approach. The redeposition rate was greater during the second period, at most sites. While wind/wave effects may dominate suspended load concentrations at some sites, other data which characterize drainage area, water flows and biological parameters have to be known if the rate of gross sedimentation is to be estimated. Locally, the fate of settling materials depends on the resuspension terms previously described. Models to define the resultant areas of accumulation, transportation and erosion have been developed for lakes as well as coastal areas. (Miller-PTT)
W90-00734

SENSITIVE SCREENING BIOASSAY TECHNIQUE FOR THE TOXICOLOGICAL ASSESSMENT OF SMALL QUANTITIES OF CONTAMINATED BOTTOM OR SUSPENDED SEDIMENTS.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
M. Munawar, D. Gregor, S. A. Daniels, and W. P. Norwood.
Hydrobiologia HYDRB8, Vol. 176/17, p 497-507, July 3, 1989. 5 fig, 4 tab, 12 ref.

Descriptors: *Pollutant identification, *Suspended sediments, *Bottom sediments, *Bioassay, Sediments, Toxicology, Limited supply bioassay.

Conventional methods of sediment bioassessment require relatively large quantities of the sample; but when sample sizes are limited, these methods become ineffective. To overcome this problem, the Limited Sample Bioassay (LSB) technique was developed. Bioassays conducted with bottom sediments ad suspended particulates from western, central and Arctic regions of Canada indicted that the newly developed LSB technique successfully evaluated the contaminant/nutrient impact on laboratory-grown cultures of algae. The LSB method produced results which were comparable to those from standard elutriate bioassays conducted with natural phytoplankton size assemblages. Samples from three geographic areas are included. It is evident that both Red Deer River suspended particulate samples had a consistent enhancement of carbon assimilation. The April sample produced statistically significant effects compared with the control at the three highest treatment levels only ($P < 0.05$ -<0.001). Significant enhancement in the June sample was even more progressive ($P <$ 0.05 to P , 0.001) when compared with the control. The physiological response was similar in both samples even though there were significant differences in Cu, Mn, Ni, Pb, and Zn concentrations. Conversely, the South Saskatchewan River suspended particulate sample exhibited a consistent inhibition of carbon uptake. Although the particle sample size permitted only two treatment levels, a significant suppression of carbon assimilation was evident at the 1:16 level of treatment. Results of bottom sediment bioassays show that treatment of the Fish Lake sample from Devon Island caused significant inhibition ($P < 0.01$ -0.001), as compared to the control. The data suggest that the LSB can play an important role in providing a quick, simple, sensitive, and inexpensive screening technique for assessing the bioavailability of contaminants or nutrients from sediment of limited quantity. (Miller-PTT)
W90-00736

POTENTIAL IN FLUVIAL GEOMORPHOLOGY OF A NEW MINERAL IDENTIFICATION TECHNOLOGY (QEM*SEM).
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
S. J. Riley, R. A. Creelman, R. F. Warner, R. Greenwood-Smith, and B. R. Jackson.
Hydrobiologia HYDRB8, Vol. 176/17, p 509-524, July 3, 1989. 4 fig, 4 tab, 36 ref.

Descriptors: *Mineralogy, *Flood peak, *High water mark, *Sediments, *Fluvial sediments, *Minerals, *Scanning electron microscopy, *Flood profiles, Geology.

The value of a new technique for mineral identification in fluvial environments is discussed and its capacity on samples collected from the Nepean River, NSW, Australia is demonstrated. A new quantitative mineral identification system QEM*SEM (Quantitative Evaluation of Materials by Scanning Electron Microscope), using an image analysis system with energy dispersive spectrometry and back scatter electron responses to identify phases, has been employed to provide rapid and economic analysis of sediments; large numbers of grains are counted with a greater statistical reliability than was previously possible. Results from the survey delineate the maximum level of flooding in an environment where clearly defined flood deposits are not evident. The results suggest the flood levels to be higher than predicted from previous studies. The analysis suggests that, at the very least, there has been a flood at a height of 5 to 10 m above the highest recorded floor in 1867, which means that the recurrence interval of the flood that deposited the fine sediments is greatly in excess of 200 years. Its age is unknown, although the fact that deposit is on a hillslope suggests that it is probably Late Holocene; older deposits would have been subject to a longer period of erosion and less likely to be on a slope. (Miller-PTT)
W90-00737

MEASUREMENTS OF SEDIMENT TOXICITY OF AUTOTROPHIC AND HETEROTROPHIC PICOPLANKTON BY EPIFLUORESCENCE MICROSCOPY.
CB Research International Corp., Sidney (British Columbia).
For primary bibliographic entry see Field 5C.
W90-00738

USE OF STRONTIUM-90 IN FISH VERTEBRAE AS AN EFFLUENT EXPOSURE TRACER IN PCB-CONTAMINATED CHANNEL CATFISH.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W90-00817

VARIABILITY IN THE DETERMINATION OF ASH FREE DRY WEIGHT FOR PERIPHYTON COMMUNITIES: A CALL FOR A STANDARD METHOD.
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W90-00820

DETERMINATION OF AMMONIA IN WATER BY CENTRIFUGAL ANALYSIS.
Path Scientific Research Ltd., Halifax (Nova Scotia). Environmental Chemistry Lab.
For primary bibliographic entry see Field 5A.
W90-00836

OBSERVATIONS OF CONCURRENT DRIFTING BUOY AND CURRENT METER MEASUREMENTS IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W90-00839

AUTOMATIC SYSTEM FOR SIMULTANEOUS DETERMINATION OF NITRATES AND NITRITES IN WATERS.
Universitat de les Illes Balears, Palma de Mallorca (Spain). Dept. de Chemistry.
For primary bibliographic entry see Field 5A.
W90-00859

TOWARDS A STANDARD METHOD FOR THE MEASUREMENT OF ORGANIC CARBON IN SEDIMENTS.
Colorado School of Mines, Golden.
C. M. Lee, and D. L. Macalady.
International Journal of Environmental and Analytical Chemistry IJEAA3, Vol. 35, No. 4, p 219-225, 1989. 3 tab, 13 ref.

Descriptors: *Chemical analysis, *Pollutant identification, *Soil analysis, *Lake sediments, *Organic carbon, Oxidation, Soil chemistry, Comparison studies, Potentiometers.

The precisions achieved by two different methods for analysis of organic carbon in soils and sediments were determined and compared on two EPA soils (10 and 16) and a New Hampshire lake sediment. The first method is a rapid dichromate oxidation technique (Walkley-Black) that has long been a standard in soil chemistry. The second is an automated coulometric titration method for which commercial instrumentation is available. The automated coulometric method showed relative standard deviations that were six to twenty times smaller than the dichromate oxidation technique. Development of a standardized sediment with a low level of organic carbon is recommended in order to facilitate the evaluation of the precision and accuracy of organic carbon measurement techniques. (Author's abstract)
W90-00861

HOLDING TIME FOR SAMPLES FROM A FEW SELECTED LAKES AND STREAMS: EFFECTS ON TWENTY-FIVE (25) ANALYTES.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Acid Deposition Quality Assurance Group.
For primary bibliographic entry see Field 5A.
W90-00865

ATOMIC ABSORPTION SPECTROMETRIC AND SPECTROPHOTOMETRIC TRACE ANALYSIS OF URANIUM IN ENVIRONMENTAL SAMPLES WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND 4-(2-PYRIDYLAZO) RESORCINOL.
Pondicherry Univ. (India). Salim Ali School of Ecology.
For primary bibliographic entry see Field 5A.
W90-00868

SYNERGISTIC SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROMETRIC ANALYSIS OF ZINC IN ALLOYS AND ENVIRONMENTAL SAMPLES WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND PYRIDYLAZO REAGENTS.
Pondicherry Univ. (India). Salim Ali School of Ecology.
For primary bibliographic entry see Field 5A.
W90-00869

EFFECT OF ENVELOPES ON FLOW PATTERN NEAR DRAIN PIPE.
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
C. Lennoz-Gratin.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 626-641, August 1989. 8 fig, 6 tab, 28 ref, append.

Descriptors: *Groundwater movement, *Drainage systems, *Soil tests, *Clogging, *Flow pattern, *Permeameters, Laboratory equipment, Sand, Hydraulic gradient, Vertical flow, Pipes, Cores, Mineralization, Drains.

Movements of soil particles in the vicinity of the drain lead to mineral clogging of drain pipes. It is therefore of high interest to analyze water flow patterns near the pipe in order to understand these movements. Two types of laboratory models have been designed: a rectangular sand tank with a central drain; and a simplified set-up, the permeameter, which allows a one-dimensional flow. The permeameter tests are directly derived from sand-tank experiments, where the highest values of hydraulic gradient due to upward vertical flow occur below the pipe. The permeameter is a simple device designed for submitting soil cores to these unfavorable up-flow conditions. Such a practical test is able to diagnose mineral clogging hazards and to help choose a proper envelope material. (Author's abstract)
W90-00886

STABLE PREDICTIVE CONTROL OF OPEN-CHANNEL FLOW.
Universidad Politecnica de Cataluna, Barcelona (Spain). Dept. of Applied Mathematics.
For primary bibliographic entry see Field 8A.
W90-00892

VOLATILE ORGANIC LOSSES FROM A COMPOSITE WATER SAMPLER.
Tennessee Eastman Co., Kingsport.
S. M. Cline, and B. F. Severin.
Water Research WATRAG, Vol. 23, No. 4, p 407-412, April 1989. 9 fig, 1 tab, 8 ref.

Descriptors: *Sample preservation, *Water analysis, *Volatile organic compounds, *Samplers, *Pollutant identification, *Model studies, Mathematical models, Hydrocarbons.

A commercially available composite liquid sampler was evaluated as to its suitability for sampling aqueous solutions containing dilute volatile organic constituents. Four organic compounds (1,2-dichloroethane, carbon tetrachloride, trichloroethene, and toluene) having Henry's constants 0.045-0.95 were used as analytes. The concentration of each analyte in the sampler feed and in the collected liquid was monitored by gas chromatography. In the normal operational mode, the receiving vessel was sealed, but liquid delivery resulted in venting an equivalent amount of headspace gas. In this mode, 6-42% of the analytes were lost from the sampler. A mathematical model based on instantaneous equilibrium was used to predetermine the predominate parameters related to VOC losses from the sampler. Using the model, the fraction of the analyte remaining in the liquid was dependent only upon the fill fraction of the vessel, and the constituent's Henry's constant. The average recovery for each of the model compounds was 58% for carbon tetrachloride, 68% for trichloroethene, 73% for toluene, and 94% for 1,2-dichloroethane. Thus, the water sampler tested is inadequate for the collection of aqueous streams when the volatile component of these waters is of concern; passive control of the headspace was ineffective in retaining the volatile constituents in the collected wastewater. (Peters-PTT)
W90-00900

EVALUATION OF THE STREAMING CURRENT DETECTOR--I. USE IN JAR TESTS.
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-00901

EVALUATION OF THE STREAMING CURRENT DETECTOR--II. CONTINUOUS FLOW TESTS.
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-00902

FLOW CYTOMETRY FOR ALGAL STUDIES.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
G. Premazzi, G. Buonaccorsi, and P. Zilio.
Water Research WATRAG, Vol. 23, No. 4, p 431-442, April 1989. 10 fig, 6 tab, 33 ref.

Descriptors: *Cytometry, *Instrumentation, *Algae, *Fluorescence, *Quantitative analysis, *Phytoplankton, *Laboratory equipment, *Water quality, *Bioindicators, Toxicity, Trace metals, Nitrilotriacetic acid, Laser flow cytometry.

Laser flow cytometric (LFC) instrumentation has been developed in order to make very rapid measurements on phytoplankton samples for application in water quality research. The apparatus has been specially designed to make multi-stage light scattering and autofluorescence measurements on individual cells in a flow system. Quantitative LFC measurements are made of optical characteristics on samples of a minimum of 5000 cells, with a total measurements time of <30 s. These measurements permit the identification and enumeration of algae by species. The instrumentation has been used to make the first laboratory ecotoxicological studies on freshwater phytoplankton by flow cytometry, in which the effects of trace metals and nitrilotriacetic acid on mixed algal populations were investigated. The measurements of algal light scatter patterns and autofluorescence were used to account for only live algae in trace metal toxicity studies thereby obtaining more precise values. Quantitative LFC measurements could be carried out on a cell by cell basis at speeds of 4-5 orders of magnitude faster than traditional methods. This permits the sampling frequency and volume tested to be increased which increases the statistical significance of the results. LFC could be a valuable tool for the rapid acquisition of information concerning the condition of aquatic ecosystems, using the phytoplankton community as a bioindicator for freshwater and marine environments. (PTT-Peters)
W90-00903

METHODOLOGY FOR THE ASSESSMENT OF FREQUENCY DISTRIBUTION OF COMBINED SEWER OVERFLOW VOLUMES.
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5D.
W90-00909

EVALUATION AND COMPARISON OF ION CHROMATOGRAPHY, SEGMENTED FLOW ANALYSIS AND FLOW INJECTION ANALYSIS FOR THE DETERMINATION ON NITRATE IN NATURAL SURFACE WATERS.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Inorganic Chemistry Section.
For primary bibliographic entry see Field 5A.
W90-00913

SNOW COVER OF THE UPPER COLORADO RIVER BASIN FROM SATELLITE PASSIVE MICROWAVE AND VISUAL IMAGERY.
University of Puget Sound, Tacoma, WA.
E. G. Josberger, and E. Beauvillain.
Nordic Hydrology NOHYBB, Vol. 20, No. 2, p 73-84, 1989. 12 fig, 1 tab, 9 ref.

Descriptors: *Remote sensing, *Satellite technology, *Snow cover, *Radiometry, *Upper Colorado River Basin, Microwave radiometry, Snowpack, Seasonal variation.

A comparison of passive microwave images from the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) and visual images from the Defense Meteorological Satellite Program (DMSP) of the Upper Colorado River Basin shows that passive microwave satellite imagery can be used to determine the extent of the snow cover. Eight cloud-free DMSP images throughout the winter of 1985-1986 show the extent of the snowpack, which, when compared to the corresponding SMMR images, determine the threshold microwave characteristics for snow-covered pixels. With these characteristics, the 27 sequential SMMR images give a unique view of the temporal history of the snow cover extent through the first half of the water year. Beginning mid-November, the snow-covered area rapidly increases from near zero to 80% by the middle of January. During late February the snow-covered area decreases as a result of basin-wide warming. The microwave determinations initially overestimate the decrease in snow cover, as a result of liquid water in the snowpack, but the return of cooler temperatures restores the veracity of the passive microwave determinations. (Author's abstract)
W90-00917

RADON IN GROUNDWATER: A TOOL TO ASSESS INFILTRATION FROM SURFACE WATER TO AQUIFERS.
Paul Scherrer Inst., Villigen (Switzerland).
For primary bibliographic entry see Field 2F.
W90-00945

UNCERTAINTIES IN STREAMFLOW MEASUREMENTS UNDER WINTER ICE CONDITIONS, A CASE STUDY: THE RED RIVER AT EMERSON, MANITOBA, CANADA.
SNC Group, Inc., Montreal (Quebec). Power and Heavy Civil Works Div.
For primary bibliographic entry see Field 2E.
W90-00951

7C. Evaluation, Processing and Publication

AGRICULTURAL NONPOINT SOURCE POLLUTION: MODEL SELECTION AND APPLICATION.
For primary bibliographic entry see Field 5B.
W90-00001

REVIEW OF HYDROLOGIC AND WATER QUALITY MODELS USED FOR SIMULATION OF AGRICULTURAL POLLUTION.
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-00002

DEVELOPMENTS IN ECOLOGICAL MODELLING.
Royal Danish School of Pharmacy, Copenhagen. Dept. of Pharmaceutical Chemistry.
S. E. Jorgensen.
IN: Agricultural Nonpoint Source Pollution: Model Selection and Application. Developments in Environmental Modeling, 10, Elsevier, New York. 1986. p 37-53, 4 fig, 1 tab, 18 ref.

Descriptors: *Ecosystems, *Model studies, *Water pollution effects, Mathematical studies, Path of pollutants, Sampling, Thermodynamics, Theoretical analysis, Cybernetics.

The wide use of ecological models for environmental management during the last 12-14 years has demonstrated that workable models can be developed, at least for a great number of environmental problems. The experience gained has provided guidelines for the setting up of ecological models. These guidelines are: (1) general models of ecosystem classes (lakes, rivers, forests, etc.) are nonexistent; (2) the predictive power of the model is strongly dependent on the quantity and quality of the data; (3) calibration of the most crucial parameters, which can be found by a sensitivity analysis, is always required, because the many ecological processes not included in the model are taken into account by the fine tuning of the parameters. It is therefore recommended that good literature values should be used for all parameters, and a sensitivity analysis of the parameters should be made before the calibration, and the most sensitive parameters should be selected as an acceptable calibration of 4-6 parameters is possible with the present techniques; (4) models have usually been calibrated on the basis of an annual measurements series with sampling frequency of for instance twice per month. This sampling frequency is sufficient to describe the day to day dynamics of an ecosystem. Consequently, it is recommended to work along the following lines: to use an intensive sampling program in periods where the dynamics are most pronounced, to use laboratory investigations to assess some of the crucial parameters, and to fine tune some of the most sensitive, already assessed parameters on the basis of the annual measuring program; (5) it is recommended that crucial submodels of the system either in situ or in the laboratory be examined; (6) after calibration of the model it is important to validate it, preferably against a series of measurements from a period with changed conditions; and (7) it is possible to set up a procedure for the development of ecological models. The following methods will be mentioned: the use of cybernetics, the thermodynamic function energy and the catastrophe theory. Present day experience with these new approaches is quite limited but the results obtained up to now seem very promising. (See also W90-00001) (Lantz-PTT)
W90-00003

SIMULATION OF SEDIMENT YIELD FROM ALPINE WATERSHEDS.
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W90-00007

APPLICATION OF AN AGRICULTURAL WATER BALANCE AND EROSION MODEL IN ENVIRONMENTAL SCIENCE.
Los Alamos National Lab., NM. Environmental Science Group.
For primary bibliographic entry see Field 2J.
W90-00010

VALIDITY AND LIMITATIONS OF DIFFERENT TRANSPORT MODELS WITH PARTICULAR REFERENCE TO SEDIMENT TRANSPORT.
Padua Univ. (Italy). Ist. di Idraulica.
For primary bibliographic entry see Field 2J.
W90-00011

SELECTION AND APPLICATION OF MODELS FOR NONPOINT SOURCE POLLUTION AND RESOURCE CONSERVATION.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W90-00012

SIMPLE MODELS TO EVALUATE NONPOINT POLLUTION SOURCES AND CONTROLS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W90-00013

INTEGRATION OF RUNOFF AND RECEIVING WATER MODELS FOR COMPREHENSIVE WATERSHED SIMULATION AND ANALYSIS OF AGRICULTURAL MANAGEMENT ALTERNATIVES.
Anderson-Nichols and Co., Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5G.
W90-00014

FIELD SCALE SIMULATION OF NUTRIENT LOSSES.
Padua Univ. (Italy). Ist. di Chimica Industriale.
For primary bibliographic entry see Field 5B.
W90-00015

MODELING SUBSURFACE DRAINAGE AND WATER MANAGEMENT SYSTEMS TO ALLEVIATE POTENTIAL WATER QUALITY PROBLEMS.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W90-00016

RUNOFF AND RECEIVING WATER MODELS FOR NPS DISCHARGE INTO THE VENICE LAGOON.
Padua Univ. (Italy). Ist. di Idraulica.
For primary bibliographic entry see Field 5B.
W90-00017

DISTRIBUTED PARAMETER HYDROLOGIC AND WATER QUALITY MODELING.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W90-00018

MAPPING OF SOILS AND BEDROCK SENSITIVITY TO ACIDIC DEPOSITION IN MANITOBA.
Manitoba Dept. of Environmental Management, Winnipeg. Environmental Management Services Branch.
For primary bibliographic entry see Field 5C.
W90-00074

INDIANA WATER QUALITY 1987: MONITOR STATION RECORDS, RIVERS AND STREAM.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN.
For primary bibliographic entry see Field 5B.
W90-00079

TOTAL WATER AND TAPWATER INTAKE IN THE UNITED STATES: POPULATION-BASED ESTIMATES OF QUANTITIES AND SOURCES.
National Cancer Inst., Bethesda, MD. Epidemiology and Biostatistics Program.
For primary bibliographic entry see Field 6D.
W90-00097

ESTIMATING CLIMATIC DATA.
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
E. Linacre.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 55-72, 7 fig, 3 tab, 75 ref.

Descriptors: *Climatic data, *Data collections, *Water resources data, *Data interpretation, *Climatology, *Mathematical studies, Temperature, Dewpoint, Solar radiation, Mathematical equations, Meteorology.

Estimates of climatic values contain errors due to: the measurements of proxy climatic elements, the uncertainty of empirical formulae, and the effects of period of averaging. In general, one should never estimate climatic data if it is possible to obtain good measurements. Nevertheless a good estimate (i.e., an accurate calculation from proper measurements of the independent factors, using a soundly based relationship to the dependent variable) is better than a bad measurement and better than no measurement. In particular there are four circumstances when estimation is justifiable: (1) when there are no measurements available, because none were taken at the particular place or time in the past; (2) where there is doubt about the validity of the measurements; (3) when cost prohibits present measurements; or (4) when there are concerns about the future. A stepwise consideration of the controlling processes allows useful estimation of monthly-mean temperatures and net radiation intensity. How these estimates (of temperature, net radiation, and dewpoint temperature) are best calculated mathematically, is the emphasis of this paper. (See also W90-00100) (Lantz-PTT)
W90-00105

USE OF CLIMATIC DATA TO CLASSIFY AND COMPARE ENVIRONMENTS.
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
For primary bibliographic entry see Field 2B.
W90-00106

NEW OBJECTIVE METHOD FOR SPATIAL INTERPOLATION OF METEOROLOGICAL VARIABLES FROM IRREGULAR NETWORKS APPLIED TO THE ESTIMATION OF MONTHLY MEAN SOLAR RADIATION, TEMPERATURE, PRECIPITATION AND WINDRUN.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
M. F. Hutchinson.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 95-104, 6 fig, 11 ref.

Descriptors: *Wind, *Data collections, *Water resources data, *Data interpretation, *Meteorological data collection, *Solar radiation, *Temperature, *Precipitation, Australia, Seasonal variation, Laplace equation, Mathematical studies, Climatology, Meteorology, Mathematical analysis.

The use of multi-dimensional Laplacian smoothing splines to reliably estimate a variety of meteorological variables, including monthly mean solar radiation, temperature, precipitation and windrun at regional and continental scales across Australia from irregularly spaced data networks of varying quality is described. The technique used is that of fitting multi-dimensional Laplacian smoothing spline surfaces, with the degree of smoothing objectively chosen to minimize the predictive error of the final fitted surface. The method offers distinct advantages over subjective interpolation methods and over previously developed objective interpolation methods. Moreover, the standard error estimates associated with the fitted surfaces can indicate areas where the network is inadequate and allow strategies for efficient network design to be developed. The method is a general one capable of application in a wide variety of circumstances. Successful applications within Australia to the estimation of monthly mean solar radiation in terms of latitude, longitude and precipitation; temperature in terms of latitude, longitude and elevation; precipitation in terms of latitude, longitude and elevation; and windrun in terms of latitude, longitude and distance inland from the coast, are briefly described. (See also W90-00100) (Lantz-PTT)
W90-00108

MODEL-BASED APPROACH TO THE USE OF CLIMATIC DATA FOR ASSESSING PROBABILITIES OF RAINDAY AND DRYDAY SEQUENCES.
For primary bibliographic entry see Field 2B.
W90-00112

ASSESSMENT OF RAINFALL EROSION HAZARD.
Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 2J.
W90-00113

RISK ANALYSIS OF WHEAT YIELDS IN RELATION TO CULTIVAR MATURITY AND CLIMATIC VARIABILITY IN SEMI-ARID AREAS, USING A CROP GROWTH MODEL.
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 3F.
W90-00114

SIMPLE MODELS FOR USE BY ADVISORY OFFICERS TO DEFINE CROP STRATEGIES AND TO PREDICT FARM YIELDS.
South Australia Dept. of Agriculture, Adelaide. Div. of Land Use and Protection.
For primary bibliographic entry see Field 3F.
W90-00115

USE OF CLIMATIC DATA WITH A CROP WATER BALANCE MODEL AND CROP AND PEST RESPONSE MODELS IN NORTHERN NEW SOUTH WALES.
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
For primary bibliographic entry see Field 3F.
W90-00118

BUREAU'S DATA BANK--HOW IT WORKS.
Bureau of Meteorology, Melbourne (Australia).
C. Skinner.
IN: Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia, Proceedings of a United Nations University Workshop Held at the Canberra College of Advanced Education, Belconnen, ACT, Australia, 12-15, December 1983. Technical Memorandum 89/5, April 1989. p 245-250, 7 ref.

Descriptors: *Administrative agencies, *Data collections, *Water resources data, *Climatic data, *Meteorologic data collection, Automation, Information exchange, Rainfall, Temperature, Humidity, Wind, Evaporation, Solar radiation.

An inventory of climatological data the Bureau of Meteorology, Melbourne, Australia holds, and its wide variation in quality is given, and includes: rainfall, rainfall intensity, temperatures, humidity, wind, wind run, evaporation, upper winds and radiosondes, and solar radiation. Manual and automated data collection methods are discussed. A list is given of possible problems which may be encountered in using meteorological data. Problems encountered are of two types: either the data is unreliable because of poor observing practices or transcription errors when copying to magnetic tape, or the measurements at the observing site are not representative of the district as a whole. Records can be provided on magnetic tape, microfiche, printout, and soon, 5-inch floppy disc. Hundreds of different computer analyses are available, including the following which are commonly called upon: monthly means and standard deviations--some data can also be analyzed in ten day periods; frequency analyses--the frequency of concurrent occurrences of any two quantities can be provided; listing of extremes and unusual events; runs and durations of events; rainfall decile analysis and ranking of heavy falls; fitting of statistical distributions to primary rainfalls; calculation of rainfall frequency/intensity/duration curves; calculation of accumulated temperature excess or deficit (degree-days); and computation of air trajectory before arrival at a specified point. (See also W90-00100) (Lantz-PTT)
W90-00119

COLLECTION, QUALITY AND ACCESSIBILITY OF CLIMATIC AND HYDROLOGIC DATA USED IN AGRICULTURAL APPLICATIONS IN NEW ZEALAND.
Meteorological Service, Christchurch (New Zealand).
For primary bibliographic entry see Field 7B.
W90-00120

DATA FOR ASSESSMENT OF EVAPOTRANSPIRATION AND SOIL WATER.
New South Wales Univ., Kensington (Australia). Dept. of Water Engineering.
For primary bibliographic entry see Field 2D.
W90-00121

ASPECTS OF HYDROMETEOROLOGICAL DATA, MEASUREMENT, ANALYSIS AND APPLICATION.
University of New England, Armidale (Australia). Faculty of Resource Management.
For primary bibliographic entry see Field 2B.
W90-00122

DESIGNING COST-EFFECTIVE HABITAT MANAGEMENT PLANS USING OPTIMIZATION METHODS.
National Ecology Center, Fort Collins, CO.
For primary bibliographic entry see Field 6A.
W90-00123

INDIANA WATER QUALITY 1986: MONITOR STATION RECORDS--RIVERS AND STREAMS.
Indiana Dept. of Environmental Management, Office of Water Management, Indianapolis, IN 46224.
For primary bibliographic entry see Field 2E.
W90-00127

INSTALLATION RESTORATION PROGRAM PHASE II--CONFIRMATION QUANTIFICATION, STAGE 2. VOLUME II.
Engineering-Science, Inc., Atlanta, GA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199-485. Price codes: A99 in paper copy, A01 in microfiche. Final Report, July 1988. 633p. USAF Contract F33615-84-D-4403.

Descriptors: *Military reservations, *Pollutant identification, *Data collections, *Path of pollutants, *Groundwater pollution, *Water pollution control, Water pollution sources, Aquifers, Florida, Monitoring, Geophysics, Permits.

An Installation Restoration Program (IRP) Phase II, Stage 2 investigation was conducted at MacDill AFB and Avon Park AFB, Florida, to confirm the presence or absence of contamination at twelve sites. Eight of the twelve sites were previously investigated under Phase II, Stage 1 efforts. Four sites had not previously been investigated under Phase II efforts. A field program was conducted, consisting of geophysical surveys, the drilling and installation of 28 monitoring wells, an aquifer pumping test in the surficial aquifer, and the collection and analysis of groundwater, surface water, and sediment samples. At MacDill AFB, no significant contaminants were found at two of the sites. These sites were recommended for no further action. At three other sites no significant contamination was found but other evidence suggested that additional study should be considered before specific action at these sites is recommended. Significant contamination was found at three sites and these sites were recommended for additional investigation. One site at MacDill AFB was recommended for remedial action. At Avon Park AFB, all three sites showed no significant contamination and were recommended for no further action. This volume presents the final accompanying appendix, which contains all of the analytical data reports for the restoration surveys. (See also W89-00132) (Lantz-PTT)
W90-00133

DEVELOPING A MATHEMATICAL MODEL SYSTEM FOR THE RHINE: MEUSE ESTUARY.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2L.
W90-00136

FORMULATION OF WATER QUALITY MODELS FOR STREAMS, LAKES, AND RESERVOIRS: MODELER'S PERSPECTIVE.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2H.
W90-00145

GROUNDWATER PUMPING TESTS: DESIGN AND ANALYSIS.
For primary bibliographic entry see Field 2F.
W90-00159

ANALYTICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
For primary bibliographic entry see Field 2F.
W90-00162

NUMERICAL GROUNDWATER MODELING: FLOW AND CONTAMINANT MIGRATION.
For primary bibliographic entry see Field 2F.
W90-00174

TECHNIQUES FOR ESTIMATING STREAMFLOW CHARACTERISTICS IN THE EASTERN AND INTERIOR COAL PROVINCES OF THE UNITED STATES.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W90-00203

HYDROLOGIC UNIT MAPS.
P. R. Seaber, F. P. Kapinos, and G. L. Knapp.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2294, 1987. 63p, 5 fig, 1 tab, 1 plate, 29 ref.

Descriptors: *Hydrologic unit maps, *Maps, *Hydrologic data, *River basins, Drainage area, Data collections, Water resources development.

A set of maps depicting approved boundaries of, and numerical codes for, river basin units of the United Sates has been developed by the U.S. Geological Survey. These 'Hydrologic Unit Maps' are four-color maps that present information on drainage, culture, hydrography, and hydrologic boundaries and codes of: (1) the 21 major water resources regions and the 222 subregions designated by the U.S. Water Resources Council, (2) the 352 accounting units of the U.S. Geological Survey's (USGS) National Water Data Network, and (3) the 2,149 cataloging units of the USGS 'Catalog of Information on Water Data.' The maps are plotted on the USGS State base-map series at a scale of 1:500,000 and, except for Alaska, depict hydrologic unit boundaries for all drainage basins greater than 700 square miles. A complete list of all the hydrologic units, along with their drainage areas, their names, and the names of the States or outlying areas in which they reside, is given. These maps and associated codes provide a standardized base for use by water resources organizations in locating, storing, retrieving, and exchanging hydrologic data and information, in indexing and inventorying hydrologic data and information, in cataloging water data acquisition activities, and in a variety of other applications. Because the maps have undergone extensive review by all principal Federal, regional, and State water resource agencies, they are widely accepted for use in planning and describing water use and related land use activities, and in geographically organizing hydrologic data. (Author's abstract)
W90-00207

METHODS AND COMPUTER PROGRAM DOCUMENTATION FOR DETERMINING ANISOTROPIC TRANSMISSIVITY TENSOR COMPONENTS OF TWO-DIMENSIONAL GROUND-WATER FLOW.
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 2F.
W90-00215

SPECIFIC CONDUCTANCE: THEORETICAL CONSIDERATIONS AND APPLICATION TO ANALYTICAL QUALITY CONTROL.
For primary bibliographic entry see Field 7B.
W90-00217

CONSEQUENCES OF SPATIAL VARIABILITY IN AQUIFER PROPERTIES AND DATA LIMITATIONS FOR GROUNDWATER MODELLING PRACTICE.
For primary bibliographic entry see Field 2F.
W90-00227

CONSEQUENCES OF SPATIAL VARIABILITY IN AQUIFER PROPERTIES AND DATA LIMITATIONS FOR GROUNDWATER MODELLING PRACTICE.
For primary bibliographic entry see Field 2F.
W90-00228

CONCEPT OF PREDICTIVE PROBABILITY AND A SIMPLE TEST FOR GEOSTATISTICAL MODEL VALIDATION.
Stanford Univ., CA. Dept. of Civil Engineering.
P. K. Kitanidis.
IN: Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice. International Association of Hydrological Sciences, Wallingford, England. IAHS Publication No. 175, 1988. p 178-190, 1 fig, 13 ref. NSF Grant ECE-8517598, Minnesota Water Resources Center Grant USDI 14-08-0001-G-11025-02.

Descriptors: *Geophysics, *Model studies, *Probabilistic process, *Groundwater movement, Mathematical models, Kriging, Mathematical analysis.

Geostatistics model selection is preceded by an exploratory analysis in which data are organized and presented in ways which bring out important features of variability and interdependence. Before using the model to make predictions, the model's consistency with the data must be double-checked. This is where 'model validation' comes in. Unfortunately, there is no single test which can be used to prove or disprove a model or to identify peculiar measurements. Instead, one proceeds cautiously by developing tests which compare the behavior of the actual data with the possible model inadequacy, such as whether the mean square error calculated using the model is good measure of the actual square error of estimation. Of particular interest are tests which check the model's performance under conditions as similar as possible to those under which the model will be asked to perform. The concept of predictive probability which was derived for the model used in linear geostatistics (kriging, universal kriging, cokriging, etc.) when the covariance is known, is discussed. The, the predictive probability is used to derive the probability density function of a statistic which can be used to check against overestimation or underestimation of the mean square error. (See also W90-00227) (Lantz-PTT)
W90-00230

STOCHASTIC FINITE ELEMENT ANALYSIS OF GROUNDWATER FLOW USING THE FIRST-ORDER RELIABILITY METHOD.
Missouri Univ.-Rolla. Dept. of Geological Engineering.
For primary bibliographic entry see Field 2F.
W90-00231

INFLUENCE OF SPATIAL VARIABILITY OF AQUIFER AND RECHARGE PROPERTIES IN DETERMINING EFFECTIVE PARAMETER VALUES.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 2F.
W90-00232

REVIEW OF ACID RAIN MODELS FOR EUROPE.
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5B.
W90-00233

ADVANCED INFORMATION SYSTEM OF WATERWORKS, (IN JAPANESE).
For primary bibliographic entry see Field 5F.
W90-00255

AGNPS: A NONPOINT-SOURCE POLLUTION MODEL FOR EVALUATING AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 5B.
W90-00337

STATISTIC USEFUL FOR CHARACTERIZING PROBABILITY DISTRIBUTIONS, WITH APPLICATION TO RAIN RATE DATA.
Applied Research Corp., Landover, MD.
R. Martin.
Journal of Applied Meteorology JAMOZX, Vol. 28, No. 5, 1989. 1 fig, 4 tab, 14 ref.

Descriptors: *Statistical methods, *Probabilistic process, *Rainfall distribution, *Rainfall, Rain, Precipitation, Mathematical studies.

Two of the approaches to the statistical description of data are the fitting of an analytic distribution to the data with maximum likelihood techniques to determine values of the parameters of the distribution, or the calculating of various moments or other statistics from the data set that then serve as a summary of its properties. An example of the latter approach is presented, with quantity derived from consideration of an inequality for distribution functions. The value of this quantity from a data set is a statistic that can be compared with the theoretical values calculated for various distributions to determine if the sample might have come from a parent population with a given distribution. As an example, this statistic is calculated for radar and point rain rate data from the Global Atmospheric Research Program's Atlantic Tropical Experiment (GATE), and shows that the data are probably neither exponentially nor lognormally distributed. The daily values of the statistic are surprisingly constant, being about 0.3 from day to day and month to month during the GATE experiment. (Friedmann-PTT)
W90-00349

OVERLAND FLOW MODELING: CAN RAINFALL EXCESS BE TREATED AS INDEPENDENT OF FLOW DEPTH.
Technische Univ., Vienna (Austria). Inst. fuer Hydraulik Gewasserkunde und Wasserwirtschaft.
For primary bibliographic entry see Field 2E.
W90-00350

SALT INTRUSION MODEL FOR HIGH-WATER SLACK, LOW-WATER SLACK, AND MEAN TIDE ON SPREAD SHEET.
Euroconsult, Arnhem (Netherlands).
H. H. G. Savenije.
Journal of Hydrology JHYDA7, Vol. 107, No. 1-4, p 9-18, March 30 1989. 1 fig, 3 tab, 6 ref.

Descriptors: *Salt balance, *Saline water intrusion, *Estuaries, *Model studies, *Saline water, *Tidal currents, Tidal hydraulics, Salinity, Hydraulic models.

Steady-state salt intrusion models can be divided into low water-slack models, mean tidal models, and high-water slack models. Measurements of salt intrusion in estuaries is best carried out at high-water slack (HWS). A steady-state model is presented that can calculate the low-water slack and mean tidal salt intrusion from the calibrated HWS salt intrusion. A relation is presented between the dispersion coefficients at HWS, low-water slack (LWS) and at mean tide. The model was widely tested in four Mozambican estuaries, with the dispersion coefficient at HWS obtained by fitting the model to HWS salinity measurements. By varying the tidal excursion, the LWS intrusion curve is subsequently computed to fit the LWS salinity measurements. The mean tidal salinity curve is also computed. The model has been adapted for use on spread sheet, which makes the model accessible for computer use. (Friedmann-PTT)
W90-00351

NUMERICAL ANALYSIS OF LARGE DIAMETER WELLS WITH A SEEPAGE FACE.
Centre for Water Resources, Madras (India).
For primary bibliographic entry see Field 2F.
W90-00354

SIMPLE EMPIRICAL MODEL OF ROOT WATER UPTAKE.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 2I.
W90-00355

PARTICLE TRAVEL TIMES OF CONTAMINANTS INCORPORATED INTO A PLANNING MODEL FOR GROUNDWATER PLUME CAPTURE.
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 5B.
W90-00356

EVALUATION OF THE FACTORS DETERMINING THE EFFECTIVENESS OF WATER QUALITY BUFFER ZONES.
Dept. of Geography and Planning, East Carolina University, Greenville, NC 27858.
For primary bibliographic entry see Field 5G.
W90-00359

NUMERICAL MODELING OF A MULTI-AQUIFER SYSTEM IN EASTERN SAUDI ARABIA.
Arriyadh Development Authority, Riyadh (Saudi Arabia).
For primary bibliographic entry see Field 2F.

W90-00363

STOCHASTIC APPROACH OF THE HYDRODYNAMIC DISPERSION IN A FRACTURED MEDIUM: VARIABILITY OF THE DISPERSION COEFFICIENT (APPROCHE STOCHASTIQUE DE L'HYDRODISPERSION EN MILIEU FISSURE: VARIABILITE DU COEFFICIENT DE DISPERSION).
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
For primary bibliographic entry see Field 2F.
W90-00370

CANOPY SHADING EFFECTS ON SOIL HEAT AND WATER FLOW.
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W90-00378

STORAGE-YIELD RELATIONSHIPS FOR RESERVOIRS BY A SEQUENTIAL-OPERATION ALGORITHM AND COMPARISONS WITH GOULD'S PROBABILITY MATRIX METHOD.
Cukurova Univ., Adana (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W90-00576

FIELD APPLICATION OF A FINITE-ELEMENT WATER-QUALITY MODEL TO A COAL SEAM WITH UCG BURNS.
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5B.
W90-00577

STORM DRAIN DESIGN: DIFFUSIVE FLOOD ROUTING FOR PCS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 8A.
W90-00633

MODELLING OF NITRIFICATION AT THE MOGDEN TREATMENT WORKS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W90-00774

BEHAVIOUR AND MODELLING OF NTA DEGRADATION IN ACTIVATED SLUDGE SYSTEMS.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5D.
W90-00775

PRECIPITATION OF FERRIC PHOSPHATE IN ACTIVATED SLUDGE: A CHEMICAL MODEL AND ITS VERIFICATION.
California Univ., Berkeley. Dept. of Civil Engineering.
C. Luediecke, S. W. Hermanowicz, and D. Jenkins.
Water Science and Technology WSTED4, Vol. 21, No. 4-5, p 325-337, July 18 1989. 9 fig, 2 tab, 12 ref.

Descriptors: *Chemical precipitation, *Model studies, *Wastewater treatment, *Activated sludge process, *Phosphates, *Phosphorus removal, Municipal wastes, Chemical properties, Adsorption, Activated sludge, Effluents, Hydrogen ion concentration.

A chemical model of ferric phosphate precipitation was developed describing ferric hydroxy-phosphate precipitation either alone or together with ferric hydroxide. Conditions for formation of one or two precipitates are examined. The model also incorporates an additional mechanism for phosphate removal through adsorption of PO4(3-) ions on the precipitate. Experimental verification of the proposed model was carried out in lab-scale batch and continuous activated sludge units fed with municipal primary effluent and at five pH values in the range of 6.5 to 8.0. Solubility of ferric phosphate in the activated sludge system was significantly different from that reported in the literature for distilled water systems and was pH-dependent with a minimum at pH of approx. 7.0. It is proposed that the composition of precipitating ferric hydroxy-phosphate can be represented by the empirical formula Fe2.5PO4(OH)4.5. Corresponding solubility product was estimated at pKsp=96.7. The adsorption mechanism has an important effect on total phosphate removal, especially at low residual phosphate concentrations. (Author's abstract)
W90-00776

CONCEPT OF SOLUBLE RESIDUAL PRODUCT FORMATION IN THE MODELLING OF ACTIVATED SLUDGE.
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W90-00777

DYNAMIC MODELLING OF TRACE CONTAMINANT REMOVAL IN A MUNICIPAL SEWAGE TREATMENT PLANT.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W90-00778

LOTUS 1-2-3 APPLIED TO FLOW ESTIMATING AND I/I CONTROL.
Programmed Instruments, Inc., Yardley, PA.
L. G. Hale.
Public Works PUWOAH, Vol. 120, No. 9, p 54-56, August 1989. 1 fig, 1 tab.

Descriptors: *Microcomputers, *Spreadsheets, *Flow profiles, *Data processing, *Data storage and retrieval, *Data interpretation, *Computer programs, Lotus, Computer models, Flow characteristics.

By coupling the power of the spreadsheet with engineering expertise, a reasonably convenient way to estimate flow for a very wide range of combinations from relatively little information is provided. The spreadsheet also allows the user to make an unlimited series of data changes and 'educated guesses' and view the total effects in seconds. Once assembled, the spreadsheet automatically adds the typical flow to the net inflow to show total flow for any combination of domestic flow, groundwater infiltration, and storm inflow. From this information a theoretical model can be easily created. The objective is to assemble a rough model that can be used with field flow measurement projects. Specific uses of the model include: before-and-after analysis of I/I control programs; updating a flow definition when population changes occur; and a simple means of making alterations for specific methodologies. (White-Reimer-PTT)
W90-00793

RIVER QUALITY MODELING: TIME DOMAIN APPROACH.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5B.
W90-00889

LP OPERATION MODEL FOR ON-DEMAND CANAL SYSTEMS.
Agricultural Research and Education Center, Fort Pierce, FL.
For primary bibliographic entry see Field 3F.
W90-00891

DEPTH DISTRIBUTION OF AN APPLIED TRACER IN GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2F.
W90-00933

ALGORITHM FOR THE INTERPRETATION OF GROUNDWATER FIELD EXPERIMENTS.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2F.
W90-00934

STOCHASTIC-DETERMINISTIC NATURE OF AN ELEMENTAL RAINFALL RUNOFF PROCESS.
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-00946

SCALE DEPENDENCE OF CONTINUUM MODELS FOR FRACTURED BASALTS.
Westinghouse Hanford Co., Richland, WA. Environmental Div.
For primary bibliographic entry see Field 2F.
W90-00950

MATCHING A FIELD TRACER TEST WITH SOME SIMPLE MODELS.
Auckland Univ. (New Zealand). Dept. of Theoretical and Applied Mechanics.
For primary bibliographic entry see Field 2F.
W90-00953

SOURCE AREAS, DRAINAGE DENSITY, AND CHANNEL INITIATION.
California Univ., Berkeley. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W90-00955

MODELLING THE IRRIGAITON NEED.
For primary bibliographic entry see Field 3F.
W90-00957

8. ENGINEERING WORKS

8A. Structures

INTAKE STRUCTURE OPERATION STUDY, LOST CREEK DAM, OREGON.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Div.
S. E. Howington.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-210588. Price codes: A05 in paper copy, A01 in microfiche. Technical Report HL-89-13, July 1989. Final Report. 80p, 25 fig, 5 tab, 20 ref, 2 append.

Descriptors: *Dam effects, *Water resources development, *Intakes, *Hydraulic models, *Ecological effects, Fisheries, Oregon, Hydraulic structures, Reservoir releases, Mathematical models, Model studies, Seasonal variation, Lost Creek Dam.

This report documents an investigation into reservoir release operations at the Lost Creek Dam, Oregon. The dam is located on the pristine Rogue River which provides habitat to a valuable anadromous fishery. This fishery is highly temperature sensitive. The US Army Engineer District, Portland, presently uses multiple-level selective withdrawal technology to meet the established downstream temperature targets that would best suit the fishery. These target temperatures are being adequately approximated in the releases for portions of the year. However, in the fall, winter, and early spring, the releases are warmer than desired. This problem is thought to be contributing to a lower-than-desirable survival rate among the young sal-

monids. To develop a prediction capability for the intake structure, the site specific characteristics of selective withdrawal and simultaneous multiple-level withdrawal were studied. A 1:80-scale physical model was constructed and tested in both density-stratified and homogeneous density environments. The results of these studies were incorporated into an existing numerical model (SELECT) that predicts intake port openings to achieve release targets. The results of the physical model work followed logically that from similar, previously conducted studies. The OSPACE model, an optimization routine surrounding a one-dimensional reservoir thermal model, was then used to evaluate the effects of short-term operational modifications on the reservoir's long-term ability to meet release targets. Each day in the year was assigned a priority and a release temperature deviation tolerance by the sponsor. These data were used to develop a function for comparing the relative worth of meeting prescribed targets during different periods. These evaluations indicated that some potential for improving the fall release temperatures existed, but only by sacrificing the agreement between releases and targets during the summer. An alternative set of target temperatures was produced that provide inherent resource conservation when used on a daily basis in lieu of the original targets. (Author's abstract)
W90-00099

BLACK CREEK NO. 53, MISSISSIPPI, MAY 1983: SPILLWAY PERFORMANCE REPORT.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-114235. Price codes: A03 in paper copy, A01 in microfiche. 40p, 2 fig, 4 tab, 2 append.

Descriptors: *Mississippi, *Spillways, *Erosion, Erosion control, Mississippi, Hydraulic structures, Flood control, Clays, Loess, Black Creek, Rainstorms, Performance evaluation.

Mississippi experienced a major rainfall during the period of May 15-20, 1983. As much as 5 inches of rain fell on May 15 and up to 9 inches fell from May 18-20. Thus, during the six day period from May 15th to 20th, rainfall totaled 14 inches. Emergency spillway began at Black Creek No. 53 on May 19, and the flow breached the emergency spillway and removed soil and rock materials down to the floodplain level. The eroded materials were loose sand and gravel lenses, massive loess layers of up to twenty feet in thickness, clay, and clay shale. The downstream damage was severe with the most significant problem being the deposition in the stream and on the floodplain. However, the flow did remove a metal bridge on a county road, which was 1.5 miles downstream of the dam, and severely eroded the road. The flow also breached two small levees in the Mississippi River delta floodplain. Certain spillway layout features and maintenance activities may accentuate the potential for erosion. The one observed at this site was major changes in slope in the emergency spillway exit channel greatly increase the potential for flow erosion. The road cut across the exit end of the emergency spillway formed a vertical drop which was a beginning point for erosion. Once the erosion begins, it may accelerate rapidly, particularly in the soil materials at this site. (Lantz-PTT)
W90-00156

KENTUCKY, MAY 1984: SPILLWAY PERFORMANCE REPORT.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-114730. Price codes: A03 in paper copy, A01 in microfiche. 31p, 1 fig, 4 tab, 2 append.

Descriptors: *Kentucky, *Dams, *Spillways, *Erosion, Erosion control, Flow profiles, Embankments, Performance evaluation, Rainstorms, Flood control.

Kentucky experienced a major rainstorm during May 5-7, 1984. Although the storm covered a large area, some of the more intense rainfall cells occurred over the western part of Kentucky where up to 11 inches of rain fell during this storm. Emergency spillway flow occurred at several PL-566 watershed project dams. At these dams, the maximum elevation differences between reservoir water surface and the crest of the emergency spillway was 6.2 ft. Two of these dams experienced flow over a portion of their embankments, adjacent to the emergency spillway, with no erosion to the embankments. The spillway flows caused erosion at the sites, varying from very slight to severe. The erosion did not seriously threaten the integrity of the spillways with the exception of the spillway at one site. Three PL-566 watershed projects were most affected by this storm. These are Upper Tradewater River Watershed, West Fork of Pond River Watershed, and East Fork of Pond River Watershed. Certain spillway layout features and maintenance activities tend to minimize the erosion caused by the flow. Those observed were: (1) a layer of soil which is one foot thick or greater over rock material was not 'rafted' from the spillway by the flow; and (2) a good, uniform stand of vegetation greatly increases the erosion resistance of soil material. (Lantz-PTT)
W90-00157

FLOODWATER RETARDING STRUCTURE NO. 4, MISTEGUAY CREEK, MICHIGAN: SPILLWAY PERFORMANCE REPORT FOR FLOW OF SEPTEMBER 1985.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-114748. Price codes: A03 in paper copy, A01 in microfiche. 14p, 1 fig, 4 tab, 2 append.

Descriptors: *Flood control, *Dams, *Spillways, *Erosion, *Michigan, Hydraulic structures, Soil properties, Silt, Clays, Particle size, Performance evaluation, Misteguay Creek.

Michigan experienced a major rainfall on September 6, 1985 in Saginaw, Genessee, and Shiawassee counties. As much as twelve inches of rain fell during the nine-hour duration of the storm. In the vicinity of the Misteguay Watershed, the maximum rainfall during this storm was nine inches. The Misteguay Watershed project primarily consists of three floodwater retarding dams--sites 2A, 3A, and 4 which are in series. Site 4 is the most downstream site. All of the sites are classified as Class (a). The emergency spillway at Misteguay Creek Site 4 was excavated in natural earth materials and consisted of six parallel channel bays each fifty feet wide. The exit channel for the two spillway bays nearest the dam exited onto a natural slope of 15% which abruptly flattened at the floodplain. The other four bays of the spillway exited on natural slopes which were flatter than 16%. The beach and material, which was underlying the topsoil in bay 1, consists of nonplastic, silty, fine sand soils (SM) which are, inherently, highly erodible. Once the flow directly attacked the sand material it was removed very quickly. This lead to the smaller headcut in bay 1 which may have progressed from the downstream end of bay 1 to the upstream end of the spillway level crest section. The glacial till below the sand consists of low plasticity (PI averages 10), low liquid limit (averages 25) clay (CL). Particles of the till finer than 0.005 mm are disaggregated and tend to behave as discrete, ultra-fine, silt-like particles; however, the till's high unit weight indicates that it is well compacted (106% of standard Proctor density), and this probably accounts for its resistance to fluvial erosion. The glacial till has a blocky soil structure characterized by vertical, hairline joints that are well-developed in its upper three feet and moderately developed to at least 15 ft. During the period of spillway flow, the columnar blocks bounded by these cracks tended to break away and fall into the gully enabling the gully to widen and migrate upstream. Also, the till is comprised of randomly distributed, heterogeneous materials, ranging from clay particles to boulders. The turbulent flow liberated boulders and cobbles from the matrix of the blocks of till, and these materials abraded the floor of the gully. The flowing water readily removed the resulting disaggregated soil. (Lantz-PTT)
W90-00158

ANALYSIS OF ALTERNATIVE MODIFICATIONS FOR REDUCING BACKWATER AT THE INTERSTATE HIGHWAY 10 CROSSING OF THE PEARL RIVER NEAR SLIDELL, LOUISIANA.
Geological Survey, Bismarck, ND. Water Resources Div.
G. J. Wiche, J. J. Gilbert, D. C. Froehlich, and J. K. Lee.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2267, 1988. 48p, 33 fig, 15 tab, 8 plates, 25 ref.

Descriptors: *Hydraulic structures, *Highways, *Highway runoff, *Louisiana, *Model studies, *Pearl River, Slidell, Flood plain management, Flood plains, Simulation analysis, Hydraulic models, Floods.

In April 1979 and April 1980, major flooding along the lower Pearl River caused extensive damage to homes located on the flood plain in the Slidell, Louisiana, area. A two-dimensional finite element surface water flow modeling system was used to study the effect of four alternative modifications for improving the hydraulic characteristics of the Interstate Highway 10 crossing of the flood plain near Slidell. The analysis used the model's capability to simulate changes in flood plain topography, flood plain vegetative cover, and highway embankment geometry. Compared with the existing highway crossing, the four alternative modifications reduce backwater and average velocities through bridge openings for a flood of the magnitude of the 1980 flood. The four alternatives also eliminate roadway overtopping during such a flood. Downstream from Interstate Highway 10, modeling of the four alternatives indicates that backwater and drawdown still occur on the east and west sides of the flood plain, respectively, but are less than the values computed for the April 1980 flood with Interstate Highway 10 in place. In addition to other highway crossing modifications, alternatives 2 and 3 include simulation of a new 2,000-foot bridge opening, and alternative 4 includes simulation of a 1,000-foot bridge opening. The new bridge conveys 25, 23, and 21 percent of the total computed discharge in alternatives 2, 3, and 4, respectively. (Lantz-PTT)
W90-00199

HYDRAULIC CALCULATIONS FOR FLOW UNDER DIKES ON CONSOLIDATED BEDS (UNTERGRUNDHYDRAULISCHE BERECHNUNGEN AN FLUSSDEICHEN AUF BINDIGEN DECKSCHICHTEN).
Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
For primary bibliographic entry see Field 2F.
W90-00257

DYNAMIC LOAD TESTING OF PILES (KYNAMISCHE TRAGFAEHIGKEITSPRUEFUNGEN BEI BOHRPFAEHLEN).
Bilfinger und Berger Bauaktiengesellschaft, Mannheim (Germany, F.R.).
For primary bibliographic entry see Field 8G.
W90-00262

STUDY OF A FLOATING WAVE DEFLECTOR (UNTERSUCHUNG EINES SCHWIMMENDEN WELLENABWEISERS).
Versuchsanstalt fuer Binnenschiffbau e.V., Duisburg (Germany, F.R.).
H. H. Heuser, E. Mueller, and J. Landgraf.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80012/GAR. Price codes: E07 in paper copy, A01 in microfiche. December 1985. 22p, 8 fig, 2 ref. English summary.

Descriptors: *Breakwaters, *Jetties, *Wave action, Harbor installations, Zig-zag shape, Wavelengths, Attenuation, Effectiveness.

Harbor installations which are built directly on the coast, may be greatly exposed to the seas. Devices for breaking up and attenuating waves are therefore required. Solid and floating structures can be used. A new type of floating wave attenuator of the double reflection type was examined in limited

depths of water. The individual segments of the breakwater are connected to each other, displaced by 90 degrees, so that a zig-zag shaped structure is formed. The waves impinging on it are therefore deflected by plus or minus 90 degrees when they run up the breakwater. The deflected waves are again reflected on the opposite leg and there is another deflection through 90 degrees. There were very good attenuation properties for short wavelengths. However, with increasing wavelength, the effectiveness of this floating wave attenuator decreases. With short seas, this wave attenuator structure proved to be superior to all previously known systems of this type. (Author's abstract)
W90-00266

ENGINEERING SOLUTION TO THE NITRATE PROBLEM OF A BOREHOLE AT SWAFFHAM, NORFOLK, U.K.
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 5G.
W90-00366

EFFECTS OF FLOW AND WEIR DESIGN ON THE PASSAGE BEHAVIOR OF AMERICAN SHAD AND SALMONIDS IN AN EXPERIMENTAL FISH LADDER.
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 8I.
W90-00616

STORM DRAIN DESIGN: DIFFUSIVE FLOOD ROUTING FOR PCS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
J. D. Bowen, A. D. Koussis, and D. T. Zimmer.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1135-1150, August 1989. 2 fig, 4 tab, 14 ref, append.

Descriptors: *Flood routing, *Urban hydrology, *Computer models, *Computer programs, *Branch sewers, *Sewer systems, *Hydraulic engineering, Hydraulic design, Dimensional analysis, Hydrographs, Advection, Diffusion coefficient, Numerical analysis, Hydrologic properties, Morphology, Water depth, Flow discharge, Conduits, Pipe flow, Fortran.

DEMOS is an interactive model for the analysis and design of dendritic sewer networks. It routes hydrographs and pollutographs through conduits and detention basins on the basis of the one-dimensional advection-diffusion equation. The equations are solved numerically by exploiting the numerical diffusion inherent in the infinite difference approximation to a simple advection equation. The model parameters may then be related to the hydromorphologic characteristics of the system. Steady or looped rating curves may be used to convert between flows and depths. The conduit geometry may be circular or trapezoidal. The model accomplishes pipe design by selecting pipe sizes that ensure open channel flow at all times, while accounting for transient, nonuniform flow conditions and storage in the conduit. For flow simulation, surcharging is identified, and a simple flow volume storage procedure is undertaken. The model includes several features that allow for easy implementation on a variety of systems, including microcomputers. Use of the microcomputer version of DEMOS, a public domain FORTRAN code, is demonstrated in an example that involves the simulation and design of a branched sewer network. (Author's abstract)
W90-00633

FROM EXPERIMENTAL TO LARGE TIDAL POWER STATIONS (20TH ANNIVERSARY OF THE KISLOGUBSK TIDAL POWER STATION).
For primary bibliographic entry see Field 8C.
W90-00787

INVESTIGATIONS AT THE KISLOGUBSK TIDAL POWER STATION.
For primary bibliographic entry see Field 8C.
W90-00788

SOIL-CEMENT AS A MATERIAL FOR CONSTRUCTING DAMS.
For primary bibliographic entry see Field 8F.
W90-00789

EXPERIMENTAL INVESTIGATIONS OF GROIN SYSTEMS OF AN UNCONVENTIONAL LAYOUT.
A. V. Kalinovskii, and N. G. Pivovar.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 705-710, June 1989. 2 fig, 2 tab, 13 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 41-45, December, 1988.

Descriptors: *Groins, *Shore protection, *Breakwaters, *Jetties, Sediment control, Structural models, Erosion, Wave action, Sediment transport, Water currents.

In order to improve the functional qualities of sediment-retaining groins and to reduce the unit cost of groin protection, a study of the sediment-retaining capacity of groin systems of various planar layouts was carried out on a three-dimensional erodible model of a shore made of natural material (medium sand S sub av =0.34 mm) and with distortion of the horizontal scale. The deformations of the erodible model of the underwater shore shoal and beach were determined by successive levelings along surveying lines secured on the model as fixed points every 0.5 m along the slope. From the data of successive levelings of the slope of the model combined transverse profiles of the shore slope and beach were constructed, which were subsequently used for determining the areas of erosion and accretion within the limits of the wave action. It was determined that the interception and accretion of sediments being transported by the longshore wave current are the function of the root and intermediate parts of the groin. The head part of the groin dissipates the energy of oncoming waves and protects both the stretch of the shore between the extreme and middle groins of the group and the root part of the groin from erosion by waves refracted in the intergroin space. Protection of an erodible stretch of the shore by a system of Y-shaped groins makes it possible to increase the sediment-retaining capacity of the system by 20-25% without increasing the material intensity of the groins (in comparison with the groin system of the conventional layout). (White-Reimer-PTT)
W90-00791

SLIP-LINING AVOIDS REPLACEMENT OF BREAK-PLAGUED SEWER FORCE MAIN.
June Lake Public Utility District, CA.
For primary bibliographic entry see Field 5D.
W90-00794

ENGINEERING APPROACH TO WATERLINE THRUST RESTRAINT.
New York State Dept. of Transportation, Albany.
R. A. Dennison, and P. D. Chinoy.
Public Works PUWOAH, Vol. 120, No. 9, p 75, August 1989.

Descriptors: *Thrust restraints, *Conveyance structures, *Pipelines, Force, Pressure, Costs, Restraint methods.

New developments in pipe materials and joinery, and the need to stretch municipal dollars, require that thrust restraints be more carefully designed. Almost every bend, dead end, and hydrant needs to be restrained. There are two basic ways to restrain joints or fittings. Thrust blocks provide either a weight to hold the fitting in place against a vertical force, or a bearing area that transmits the force to the soil, preventing movement in a horizontal bend. Another restraint method is connecting the bends or fittings to the pipe with a solid connection. The force is then restrained by friction between the soil and the pipe. The force acting on a fitting depends on the pressure in the pipe, the inside cross sectional area of the pipe, and the deflection angle of the bend. The exact restraint details for each system may vary and are dependent upon native soils, backfill characteristics, water system materials, and construction methods. A common thrust restraint error is the tendency for redundancy. Thrust blocking, rodding, restrained joint pipe, and retainer glands all perform the same function. A cost conscious system operator should be aware that redundant restraints are not necessary and savings can be realized without compromising the system. (White-Reimer-PTT)
W90-00795

DIVERSION PROJECT ALLEVIATES SALT-WATER INTRUSION.
Dames and Moore, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W90-00798

COPING WITH THE EFFECTS OF HIGH WATER LEVELS ON PROPERTY HAZARDS: NORTH SHORE OF LAKE SUPERIOR.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6F.
W90-00840

STABLE PREDICTIVE CONTROL OF OPEN-CHANNEL FLOW.
Universidad Politecnica de Cataluna, Barcelona (Spain). Dept. of Applied Mathematics.
J. Rodellar, M. Gomez, and J. P. Martin Vide.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 701-713, August 1989. 5 fig, 1 tab, 22 ref, append.

Descriptors: *Irrigation engineering, *Algorithms, *Automation, *Water distribution, *Open-channel flow, Discharge capacity, Water level fluctuations, Gates, Mathematical studies, Differential equations.

The idea of introducing automatic control systems in water distribution open channels has been increasingly considered in recent years. An automatic control system is basically required to monitor the process output (discharges, water levels, etc. at different points) and to use this information to manipulate in real time some gate settings in order for the output to follow the demand setpoint. An algorithm for automatic control of open-channel flow has been developed. The design of a control algorithm is essentially conditioned by two features of the open-channel dynamics: (1) the time-inverse propagation process is ill-posed--thus arise problems to get stable control and assymptotical convergence of the output to the demanded setpoint; and (2) the complete description of the propagation process is mathematically complex, requiring the use of a couple of nonlinear hyperbolic partial differential equations and a posteriori linearization around the steady state. Instead of the complete equations, the control algorithm proposed uses a simplified model of the unsteady flow to describe the open-channel behavior. This model is used in conjunction with a predictive control strategy, resulting in a control algorithm with guaranteed stability and setpoint convergence as well as mathematical simplicity. Numerical examples illustrate the effectiveness of the control algorithm. (Author's abstract)
W90-00892

8B. Hydraulics

OVERTOPPING FLOW ON LOW EMBANKMENT DAMS--SUMMARY REPORT OF MODEL TESTS.
Bureau of Reclamation, Denver, CO. Hydraulics Branch.
R. A. Dodge.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-174833. Price codes: A03 in paper copy, A01 in microfiche. Report No. REC-ERC-88-3, August 1988. 28p, 14 fig, 5 tab, 38 ref.

Descriptors: *Overflow, *Embankments, *Earth dams, *Dams, *Hydraulic models, Flow profiles, Model studies, Flow discharge.

A 1:15 scale model was used to study the relative effectiveness of different embankment protective treatments. Tests were done representing unit discharges of 40 and 86 cu ft/sec. Chute and pool mode flow occurred for all treatments tested. Chute and pool flow had less scouring power compared with the earlier less rough plane flow. A smooth hard crest cap going part way down the slope caused a deep scour hole just downstream of the cap. The same flow, after roughening and sloping part of the cap with epoxied pea gravel simulating fixed cobble roughness, scoured one-half the volume compared with plain cap test. Riprap, with a simulated maximum size of 24 inches, immediately fluidized and washed out completely. There was no indication that any of the mesh-contained treatments would fail. Flow on an embankment slope of 4:1, protected by gabbions scoured 2.5 times the volume for a gabbion protected 1:6 slope. A change of compaction from 95 to 102 percent standard Proctor density decreased scour one-half. Doubling the unit discharge increased scour by a factor of 1.4 times. Both design and modeling are hampered by lack of sufficiently verified equations for steep flow and for chute and pool flow. Therefore, these test results are relative and future research is suggested. (Author's abstract)
W90-00124

SPILLWAY PERFORMANCE REPORT, MISSISSIPPI, DECEMBER 1982.
Soil Conservation Service, Washington, DC. Engineering Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-114227. Price codes: A04 in paper copy, A01 in microfiche. Report No. SCS/ENG/RPT-SPR/MS-82, April 1985. 55p, 1 fig, 4 tab, 2 append.

Descriptors: *Erosion control, *Hydraulic properties, *Spillways, *Flood control, Vegetation, Erosion, Embankments, Mississippi, Slopes, Flow profiles.

Mississippi experienced a major rainstorm during December 25-27, 1982. Up to 9.0 inches of rain fell during the storm. Emergency spillway flow occurred at several dams, where the maximum reservoir water surfaces ranged up to 2.6 ft above the crests of the emergency spillways. One of these dams experienced flow over its embankment. The spillway flows caused damage at the sites varying from very slight damage to severe damage. Erosion extending upstream to the emergency spillway control section threatened the structural integrity of one of the sites. Certain spillway layout features, construction operations, and maintenance activities appear to accentuate the potential for erosion. Those observed were: (1) major changes in slope, for example a steep slope at the end of the spillway exit channel, greatly increase the erosion caused by the flow; (2) a road paralleling the flow in a spillway causes a flow irregularity and concentrates the flow; (3) the lack of vegetation in a spillway permits the flow to attack the unprotected soil surface; and (4) plugging of a principal spillway inlet reduces the available flood storage and increases the volume, frequency, and duration of flow in a spillway. (Lantz-PTT)
W90-00135

VIBRATION ON RECTANGULAR BARS DUE TO FLOW (STOREMUNGSBEDINGTE SCHWINGUNGEN VON RECHTECKSTAEBEN).
S. J. Callander.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80897/GAR. Price codes: E14 in paper copy, A01 in microfiche. Aug 1987. 167p, 149 fig, 9 tab, 58 ref.

Descriptors: *Flow around objects, *Hydrodynamics, *Flow characteristics, *Flow pattern, *Eddies, Hydroelectric plants, Vibration, Pressure, Model studies, Turbulance.

The long term vibration behavior of cylindrical bars of rectangular cross section, which are loaded by a flow of water, was examined experimentally. Such rectangular bars are often part of calculations for the incoming flow ducts of hydro-electric powerstations. The identification of different vibration mechanisms was of special interest. From the results of the investigations, the cylinders examined were grouped according to the excitation of the longitudinal vibrations. A theoretical model was also setup, which describes a vibration mechanism induced by movement. Further hydraulic measures were explored, which prevent or minimize longitudinal vibrations (4 types of vibration). A study of the literature for this purpose was supplemented by laboratory tests. The experimental equipment (eddy current brake, measurement technique) and results of the investigation are explained in detail. These include measurements of pressure, frequency of eddy formation, amplitude of vibration, frequencies of vibration and the exciting mechanism (turbulence, eddy flow). Final theoretical considerations of longitudinal vibrations are concerned with analyses with one or two degrees of freedom. (Author's abstract)
W90-00188

STUDY OF A FLOATING WAVE DEFLECTOR (UNTERSUCHUNG EINES SCHWIMMENDEN WELLENABWEISERS).
Versuchsanstalt fuer Binnenschiffbau e.V., Duisburg (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W90-00266

TIDALLY GENERATED RESIDUAL CURRENTS IN A SEA LEVEL CANAL OR TIDAL STRAIT WITH CONSTANT BREADTH AND DEPTH.
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W90-00322

MECHANICS OF OVERFLOW EROSION ON EMBANKMENTS: I. RESEARCH ACTIVITIES.
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 2J.
W90-00628

MECHANICS OF OVERFLOW EROSION: II. HYDRAULIC AND DESIGN CONSIDERATIONS.
Bureau of Reclamation, Denver, CO.
G. R. Powledge, D. C. Ralston, P. Miller, Y. H. Chen, and P. E. Clopper.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 8, p 1056-1075, August 1989. 8 fig, 5 tab, 22 ref, append.

Descriptors: *Bank erosion, *Bank protection, *Hydraulic engineering, *Embankments, *Flood protection, *Erosion control, *Dams, Levees, Roadbanks, Design criteria.

The hydraulics of water flowing over an embankment is considered to be the basis for understanding the erosion process during overtopping events. Information has been developed based on results of research and actual case histories of embankment dams, levees, and roadways that have experienced overtopping. Various protection systems have been developed to prevent erosion of dam, roadway, and levee embankments during overflow. Several cost-effective modifications have been made to embankment dams to permit overtopping. The knowledge gained from using these hydraulic and design considerations provides the engineer and dam owner further information in the development of cost effective measures that allow embankments to pass extreme flood events without breaching. (Author's abstract)
W90-00629

COHESIVE SEDIMENT TRANSPORT: II. APPLICATION.
Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
For primary bibliographic entry see Field 2L.
W90-00631

EFFECT OF ENVELOPES ON FLOW PATTERN NEAR DRAIN PIPE.
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
For primary bibliographic entry see Field 7B.
W90-00886

TIME OF CONCENTRATION FORMULA FOR PERVIOUS CATCHMENTS.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W90-00895

HEAD LOSS IN MANIFOLDS OR TRICKLE LATERAL: SIMPLIFIED APPROACH.
Arizona Univ., Tucson. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W90-00897

EXPERIMENTS ON SEDIMENT TRANSPORT IN SHALLOW FLOWS IN HIGH GRADIENT CHANNELS.
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W90-00942

AIR-WATER GAS TRANSFER IN OPEN CHANNELS.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W90-00944

BOUNDARY CONDITIONS ALONG PERMEABLE FRACTURE WALLS: INFLUENCE ON FLOW AND CONDUCTIVITY.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2F.
W90-00956

8C. Hydraulic Machinery

RUBBER HEAT ENGINE FOR GROUND WATER IRRIGATION IN INDIA.
For primary bibliographic entry see Field 3F.
W90-00291

SPINNING AIR BLASTS OPERATING COSTS.
Dresser Industries, Inc., Connersville, IN. Roots Div.
For primary bibliographic entry see Field 5D.
W90-00668

PUMP-CONTROL VALVES PROTECT YOUR WATER SYSTEM.
Bermad Control Valves, Anaheim, CA.
For primary bibliographic entry see Field 5F.
W90-00669

FROM EXPERIMENTAL TO LARGE TIDAL POWER STATIONS (20TH ANNIVERSARY OF THE KISLOGUBSK TIDAL POWER STATION).
L. B. Bernshtein.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 687-692, June 1989. 2 fig, 14 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 27-31, December, 1988.

Descriptors: *USSR, *Energy sources, *Powerplants, *Tidal powerplants, Costs, Construction, Energy conversion.

In 1968 the Kislogubsk Tidal Power Station (TPS) was built using a previously designed model. Tidal power provides ecologically clean energy and does

not introduce changes to the natural fluctuations in the tidal basin. One method of reducing the construction costs is the use the floated-in method of construction first proposed in the USSR. The 20-year experience of operating the Kislogubsk TPS has proved that this method has substantial advantages, especially in harsh environments. At this time, four TPSs are operating, of which one is the industrial Rance (240 mW, France) and three experimental stations: Kislogubsk (400 kW, USSR), Jiangxiang (3 MW, China), and Annapolis (20 MW, Canada). The most feasible construction by the year 2000 is the Mersey TSP, followed by the Severn in Great Britain. Taking into account the TPSs planned, the total capacity of plants on the coasts of the world oceans will be 800 million kW and annual production will be 2000 billion kWh. This potential when compared to the present energy consumption (10,000 billion kWh) shows that tidal power stations cannot have a decisive significance in solving the general energy problems of the world, but they will be important in supporting the variable part of the load curve of a number of countries and regions. (White-Reimer-PTT)
W90-00787

INVESTIGATIONS AT THE KISLOGUBSK TIDAL POWER STATION.
N. Usachev, and L. B. Bershtein.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 692-697, June 1989. 3 fig, 1 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 31-36, December, 1988.

Descriptors: *USSR, *Energy sources, *Powerplants, *Tidal powerplants, Construction, Evaluation, Design, Materials, Equipment.

The creation of the Kislogubsk tidal power station (TPS) by the floated-in method marked a turning point in the solution of the problem of utilizing tidal energy. Investigation of the TPS during the five years before being put into operation, during construction, and then during 20 years of operation made it possible to check new designs, equipment, materials, and methods of protecting them for designing large TPSs. For onsite investigations 400 monitoring and measuring instruments were embedded in the foundation, bottom, and walls of the block, of which 287 are working after 20 years of operation in a marine environment. Measurements from the reinforcement dynamometers and semiconductor thermometers combined with them made it possible to estimate the stress state of the structural members and to establish that the stress state formed as early as in the construction period and subsequently has changed only insignificantly under the effect of the temperature conditions. Investigations of the reliability of the thin-walled construction under the effect of vibration loads from operation of the unit, passage of considerable water masses, and impacts showed that the construction of the powerhouse of the TPS has rigidity exceeding the rigidity of the powerhouses of hydroelectric stations also equipped with bulb units but made from massive elements. The plant has generated 10% more electricity than the design with regulation of the maximum output and the possibility of obtaining 75% of the capacity of the unit in peak-load hours regardless of the phase of the tide. (White-Reimer-PTT)
W90-00788

POLYNOMIAL REGRESSION TO FORECAST EARTH DAM PIEZOMETER LEVELS.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
E. C. Kalkani.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 545-555, August 1989. 7 fig, 1 tab, 1 ref.

Descriptors: *Dam seepage, *Seepage, *Water level forecasting, *Earth dams, *Piezometers, Mathematical equations, Standard deviation, Regression analysis, Tailwater, Forecasting, Hysteresis.

Earth dam piezometer data vary with time depending on the total head difference between the reservoir level upstream and the tailwater level downstream. To forecast piezometer levels for expected reservoir fluctuation, a relationship is required to define the piezometer levels (dependent variable) in terms of the reservoir levels (independent variable). Polynomial regression to forecast earth dam piezometer levels gives a quadratic expression of the piezometer data variation versus reservoir level, which indicates a hysteresis of the piezometer levels at mid-reservoir levels for increasing reservoir levels compared to decreasing levels. Forecasting of the piezometer levels based on the calculated quadratic expressions gives expected piezometer values with mean square error around 10% of the standard deviation of the polynomial regression curves. (Author's abstract)
W90-00880

8D. Soil Mechanics

HYDROLOGIC DESIGN FOR RIPRAP ON EMBANKMENT SLOPES.
Nuclear Regulatory Commission, Washington, DC. Office of Nuclear Material Safety and Safeguards.
R. B. Codell.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG-1263. Price codes: A04 in paper copy, A01 in microfiche. September 1988. 81p, 21 fig, 9 tab, 15 ref, 2 append.

Descriptors: *Riprap, *Hydraulic design, *Embankments, Slope protection, Mathematical models, Rainfall-runoff relationships, Rocks, Hydrologic models, Computer programs.

Waste impoundments for uranium tailings and other hazardous substances are often protected by compacted earth and clay, covered with a layer of loose rock (riprap). This report outlines procedures that could be followed to design riprap to withstand forces caused by runoff resulting from extreme rainfall directly on the embankment. The Probable Maximum Precipitation for very small areas is developed from considerations of severe storms of short duration at mid-latitudes. A two-dimensional finite difference model is then used to calculate the runoff from severe rain events. The procedure takes into account flow both beneath and above the rock layer and approximates the concentration in flow which could be caused by a non-level or slumped embankment. The sensitivity to various assumptions, such as the shape and size of the rock, the thickness of the layer, and the shape of the embankment, suggests that peak runoff from an armored slope could be attenuated with proper design. Frictional relationships for complex flow regimes are developed on the basis of flow through rock-filled dams and in mountain streams. These relationships are tested against experimental data collected in laboratory flumes; the tests provide excellent results. The resulting runoff is then used in either the Stephenson or safety factor method to find the stable rock diameter. The rock sizes determined by this procedure for a given flow have been compared with data on the failure of rock layers in experimental flumes, again with excellent results. Computer programs are included for implementing the method. (Author's abstract)
W90-00084

OVERTOPPING FLOW ON LOW EMBANKMENT DAMS--SUMMARY REPORT OF MODEL TESTS.
Bureau of Reclamation, Denver, CO. Hydraulics Branch.
For primary bibliographic entry see Field 8B.
W90-00124

CONE PENETRATION TESTING FOR EVALUATING THE LIQUEFACTION POTENTIAL OF SANDS.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
R. R. Carter.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-178826. Price codes: A04 in paper copy, A01 in microfiche. Report No. REC-ERC-87-9, May 1988. 60p, 48 fig, 3 tab, 65 ref.

Descriptors: *Soil mechanics, *Cone penetrometers, *Liquefaction, *Sand, Soil properties, Testing procedures, Seismic properties.

The purpose of this report is to present the state of the art for the cone penetration test as an in situ tool for determining the dynamic response of sands during earthquake loading. Although a vast amount of literature has been published over the past 20 years on cone penetration testing, on the dynamic response of sands, and on their correlation, little agreement has been reached in any of these areas. The use of cone penetrometers to assess the liquefaction susceptibility of a sand is currently in its infancy. The largest problems with theoretical evaluation of liquefaction assessment based on the cone penetration test (CPT) include the lack of a basic understanding of liquefaction, the lack of a closed form solution for interpreting the CPT data, and the limited data base for development of empirical relationships. Problems associated with understanding soil behavior and limited data base may eventually be solved; however, it is doubtful that a closed-form solution will ever be derived for interpreting data obtained by the CPT. The lack of the closed-form solution will require additional assumptions or testing to be performed in conjunction with the CPT for accurate theoretical evaluation of the CPT data. For this reason, the CPT as a liquefaction assessment tool, will most likely remain as an empirical indicator of soil behavior and as an integral part of a larger select group of in situ and laboratory tests designed to complement one another. (Lantz-PTT)
W90-00125

INNOVATIVE PRODUCTS AND PROCEDURES USED ON CHOUTEAU ISLAND LEVEE RELOCATION.
Army Engineer District, St. Louis, MO.
For primary bibliographic entry see Field 8G.
W90-00154

FILTRATION BEHAVIOUR OF SOIL FILTERS (FILTRATIONSVERHALTEN UND BEMESSUNG VON ERDSTOFF-FILTERN).
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Bodenmechanik und Felsmechanik.
K. J. Witt.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80009/GAR. Price codes: E07 in paper copy, A01 in microfiche. 1986. 142p, 44 fig, 7 tab, 112 ref. English summary.

Descriptors: *Soil erosion, *Soil filters, *Earthworks, Pore size, Grain size, Model studies, Filter blocking.

The erosion of soil with infiltrating represents a potential danger in earthworks. Filters have the purpose of retaining any soil particles which may cause erosion. A detailed study is concerned with such soil filters. The method of operation of the filters and the conditions for the geometrically certain retention of eroding basic particles in the pore spaces of such a filter are dealt with. A formula was derived in order to determine the reliability of filtration. One is concerned with filter criteria, and their practical dimensioning, a model of the method of operation of soil filters, the pore structure of these filters, filter blocking and experimental investigation of filtration behavior (basic soils of equal grain size and with wide ranges). Finally, there is a report on the boundary state equations and filter dimensions. (Author's abstract)
W90-00189

EMBANKMENT CRITERIA AND PERFORMANCE REPORT: W.H. HARSHA LAKE, LITTLE MIAMI RIVER BASIN, OHIO.
Army Engineer District, Louisville, KY.
For primary bibliographic entry see Field 8E.
W90-00252

VERIFICATION OF KIRKHAM'S PROBLEM OF LAYERED SOIL DRAINAGE.
Kashmir Univ., Srinagar (India). Dept. of Agriculture.
G. J. Khan, K. N. Shukla, H. S. Chauhan, and S. Ram.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 4, p 521-529, August 1989. 5 fig, 1 tab, 3 ref, append.

Descriptors: *Mathematical models, *Drainage systems, *Soil engineering, *Hydraulic conductivity, *Impervious soils, Drain spacing, Vertical flow, Soil properties, Pervious soils, Groundwater recharge, Model studies, Simulation analysis, Flow system.

A number of mathematical theories exist for the design of a tile drainage system for steady-state and falling water table cases for homogeneous soil lying over an impermeable stratum. In a layered soil, a lower soil layer having five to ten times less hydraulic conductivity than the upper soil layer is commonly considered an impermeable layer for the purpose of adopting drain spacing formulas for a homogeneous soil layer, which may lead to misleading results. An analytical solution for steady drainage in two-layered and three-layered soils receiving vertical recharge was given by Toksoz and Kirkham. Using their theoretical solutions, Toksoz and Kirkham also developed nomographs for two-layered soils showing the relationship for drain spacing as a function of the ratio of hydraulic conductivities of the two layers and the placement of the tile in a particular soil layer, showing that for a two-layered soil the calculated drain spacing would always be smaller than the correct drain spacing, because of the presence of the second soil layer. The Hele-Shaw model can be used for obtaining experimental solutions for studies of drainage of single-layered isotropic soil overlying impervious layers. A study was undertaken to experimentally verify the theoretical solution of Toksoz and Kirkham for a two-layered soil receiving a constant steady recharge using a vertical Hele-Shaw model with tiles located in the upper layer. Comparison of the analytical solution of Toksoz and Kirkham on a simulated flow system shows good agreement. (Fish-PTT)
W90-00878

8E. Rock Mechanics and Geology

CUTOFF WALL CONSTRUCTION TO UPGRADE MUD MOUNTAIN DAM.
Army Engineer District, Seattle, WA. Seattle District.
K. D. Graybeal.
Repair, Evaluation, Maintenance, and Rehabilitation Research Program Information Exchange Bulletin, Vol. 6, No. 3, July 1989. p 5-8, 3 fig.

Descriptors: *Dam stability, *Cutoffs, *Hydraulic structures, Mud Mountain Dam, Washington, Dams, Geophysics, Borehole geophysics, Structural engineering.

Mud Mountain Dam is located on the White River 5 miles upstream and southeast of Enumclaw, Washington. The drainage area above the dam is 400 sq mi. A single-purpose flood control project constructed in 1941, it is operated to alleviate flooding in the lower Puyallup Valley. Seepage through the dam was not a recognized problem before 1985 and no seepage has ever been visible at the downstream toe area. However, the reservoir has never been filled at low pool levels below elevation 980 ft. In 1985 and 1986, eighteen borings were drilled in the dam to search for possible problem zones within the core. These geotechnical investigations showed the following: there are many zones throughout the core where loose or soft materials were indicated by ease of drilling, ease of sampler driving, and by advance of the drill casing under its own weight during cable-tool drilling; near the base of the dam where the core material is more gravelly, and within the range of normal reservoir fluctuations, the core contains many zones composed of a clean gravel matrix, with few fines. Interpretation of all data leads to the conclusion that settlement and arching of the dam core within the narrow, steep rock canyon has produced these loose zones, and/or cracks in the core. The decision was made to construct a concrete cutoff wall, keyed a minimum of 15 ft into the rock and into the Mud Mountain Complex material. At its deepest point, the cutoff wall will extend to elevation 843, more than 400 ft below the top of the dam. (Lantz-PTT)
W90-00155

EMBANKMENT CRITERIA AND PERFORMANCE REPORT: W.H. HARSHA LAKE, LITTLE MIAMI RIVER BASIN, OHIO.
Army Engineer District, Louisville, KY.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199 569. Price codes: A14 in paper copy, A01 in microfiche. 284p, 12 tab, 122 plates, 2 append.

Descriptors: *Embankments, *Dams, *Hydraulic structures, *Dam construction, *Flood protection, *Ohio, Geology, Project planning, Dam construction, Grouting, Drilling, Cofferdams, Spillway, Flood protection, Performance evaluation, Little Miami River.

The principal purpose of the project is to furnish flood protection in the East Fork and Little Miami River valleys and to reduce flood stages at all points downstream along the Ohio River. The reservoir project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River basin. Secondary purposes of the project are to provide storage for water supply and water quality control for recreation and fish and wildlife activities. This performance and criteria report provides a stepwise detailing of project construction from clearing operations and foundation stripping, through drilling, grouting, gage settling, blasting, cofferdam flooding, embankment construction, spillway operation, and project completion. (Lantz-PTT)
W90-00252

8F. Concrete

THERMAL STRESS ANALYSIS OF LOCK WALL: DASHIELDS LOCKS, OHIO RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
M. I. Hammons, S. B. Garner, and D. M. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-210410. Price codes: A04 in paper copy, A01 in microfiche. Technical Report SL-89-6, June 1989. Final Report. 67p, 53 fig, 7 ref.

Descriptors: *Thermal stress, *Concrete mixes, *Materials testing, *Locks, Cracks, Hydraulic structures, Mechanical failure, Cements.

A recently developed thermal stress analysis procedure was used to study the effects of a variety of parameters on cracking in concrete overlays for the Dashields Locks, Ohio River, Pennsylvania. The objective of the research was to develop improved designs and construction procedures to substantially reduce or inhibit cracking in the concrete overlay sections. Thermal stress analyses included the effects of placement temperature, ambient temperature, thermal properties of overlay, shrinkage, creep, reinforcing steel, and restraint at the interface between the overlay and existing concrete. These analyses indicated that shrinkage was the predominant factor in overlay cracking for the particular mixture to be used on the project. It was recommended that shrinkage be reduced by adopting one or more of the following modifications: decreasing the cement content of the mixture, decreasing the water-cement ratio of the mixture, using a larger maximum size aggregate, or limiting drying shrinkage by using wet curing. It was also demonstrated that an effective bond breaker at the interface would eliminate cracking. (Author's abstract)
W90-00088

CUTOFF WALL CONSTRUCTION TO UPGRADE MUD MOUNTAIN DAM.
Army Engineer District, Seattle, WA. Seattle District.
For primary bibliographic entry see Field 8E.
W90-00155

SOIL-CEMENT AS A MATERIAL FOR CONSTRUCTING DAMS.
I. G. Boikova, M. V. Vitenberg, and V. G. Mel'nik.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 698-703, June 1989. 5 fig, 1 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 36-40, December, 1988.

Descriptors: *Soil cement, *Dams, *Earth dams, *Concrete dams, *Hydrologic systems, Compaction, Strength, Deformation, Seepage, Structure, Strength, Structural bonds.

In order to broaden the applicability of soil-cement in hydrotechnical construction, investigations were conducted to determine the physical and mechanical properties of soil-cement on a base of low-strength soils of the argillite, siltstone, shale, etc., type obtained from sedimentary rocks. The strength, deformation, and seepage properties of the soil-cement were tested using a variety of low-strength soils. The results showed that the strength and seepage properties of soil-cement depend on its structure that formed during the preparation and compaction of the mixture, and on the strength of the structural bonds forming during interaction of the soil with the binder. The type of structure of the hardened soil-cement depends on the type of soil being stabilized, on its grain-size distribution, and can be tentatively divided into 'floating' and 'porous'. Calculations and experimental investigations of the stress-strain of dams with soil-cement elements were carried out to determine the possible area of use of soil-cement in dam construction. The results of one of the experiments confirm that the construction of soil-cement fragment in the base of the dam core leads to a decrease of settlements and reduction of tensile strains on the crest and danger of cracking. Field investigations indicated this material could be used when constructing the first phase of a dam for stabilizing the upstream slope. The use of soil-cement instead of placing limestone and gravel soil with loam filling makes it possible to build up the dam with a steeper (m=1) gradient of the upstream slope, which considerably reduces the volume of soil being placed in the shoulders and core. (White-Reimer-PTT)
W90-00789

EFFECT OF VIBRO-COMPACTION OF POLYMER-IMPREGNATED ASPHALTIC CONCRETE MIXES ON THE QUALITY OF LININGS.
L. I. Dvorkin, V. L. Shestakov, V. G. Ganchikov, and V. N. Marchuk.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 711-714, June 1989. 3 fig, 1 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 45-47, December, 1988.

Descriptors: *Concretes, *Asphaltic concrete, *Concrete additives, *Linings, Compaction, Vibrocompaction, Polymers, Clays, Sand.

The compaction of asphaltic concrete and polymer-impregnated asphaltic concrete (PAC) by vibrators is believed to increase efficiency when constructing monolithic linings of canals, reservoirs, and other hydraulic structures. A vibrocompaction system was designed to model the process of vibro-compaction of PAC mixes by table vibrators, vibrating tampers, and partly vibrating rollers. The device represented a vibrating system containing a mold with the PAC mix located on an elastic base and a vibrator with elastic springs and a moving point of suspension. Two types of soil were investigated in conformity with building codes: fine sand (content of particles of size 0.1mm 75%) and clay material with consistency index I sub L < 0. It was determined that the character of the process of compacting a PAC mix on sand and on clay materials has substantial differences. On sand, vibro-compaction is more effective

with a high value of acceleration, 100 m/sq sec; on clay materials the highest quality of compaction occurs with insignificant acceleration of vibrocompaction, 40 m/sq sec. It was also established that PAC mixes are compacted more effectively on sand having a modulus of deformation not lower than 40 MPa. If the modulus of deformation of the base is lower, it is recommended to strengthen and additionally compact it. On clay materials having a low modulus of deformation, the quality of compaction of the PAC mix is low, and therefore it is recommended to strengthen them. (White-Reimer-PTT)
W90-00792

8G. Materials

THERMAL STRESS ANALYSIS OF LOCK WALL: DASHIELDS LOCKS, OHIO RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8F.
W90-00088

CONE PENETRATION TESTING FOR EVALUATING THE LIQUEFACTION POTENTIAL OF SANDS.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 8D.
W90-00125

INNOVATIVE PRODUCTS AND PROCEDURES USED ON CHOUTEAU ISLAND LEVEE RELOCATION.
Army Engineer District, St. Louis, MO.
T. L. Atchley.
Army Corps of Engineers Repair, Evaluation, Maintenance, and Rehabilitation Research Program Information Exchange Bulletin, Vol. 6, No. 3, July 1989. p 1-4, 3 fig.

Descriptors: *Materials engineering, *Gates, *Drainage, *Levees, *Synthetic compounds, *Hydraulic structures, Plastics, Polymers, Polyethylene, Pipes, Gates, Mississippi River, Illinois, Chouteau Island.

Chouteau Island separates the Mississippi River and the Chain of Rocks Canal just upstream of Lock and Dam No. 27 at Granite City, Illinois. During the October 1986 flood of the Mississippi River, it became apparent that it would be necessary to relocate a portion of the existing levee on Chouteau Island. The new section of levee required a gravity drainage structure with a concrete gate-well and a relatively short gravity drainage pipe. The levee relocation project allowed the District to gain experience with new procedures and products. The products included high-density polyethylene (HDPE) pipe and fiber-reinforced plastic (FRP). HDPE is corrosion resistant and allows more effective joint connections than the corrugated metal pipe (CMP). The FRP products are highly resistant to corrosion and eliminate the need for periodic maintenance, such as the painting required even for galvanized metal. A sluice gate made from a synthetic material was also selected for use in the structure. The original design of the Chouteau Island gate-well called for a cast-in-place structure; however, the contractor submitted for approval a precast, two-section gate-well with the same dimensions and reinforcement as the original structure. The precast plan was approved. Both a cast iron gate and alternative synthetic gate were specified for this project. The contractor chose to furnish a synthetic gate with a steel matrix encapsulated in a high-density polymer. Usually, metal attachments are used for gate-well structures. Because of their exposure to the outside environment, and to provide a structure as maintenance free as possible, attachments chosen for the Chouteau Island gate-well are FRP products. (Lantz-PTT)
W90-00154

DYNAMIC LOAD TESTING OF PILES (KYNAMISCHE TRAGFAEHIGKEITSPRUEFUNGEN BEI BOHRPFAEHLEN).
Bilfinger und Berger Bauaktiengesellschaft, Mannheim (Germany, F.R.).
J. M. Seitz, and O. Klingmueller.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-82045/GAR. Price codes: E07 in paper copy, A01 in microfiche. 1984. 44p, 14 fig, 1 tab, 17 ref.

Descriptors: *Piles, *Load testing, Strains, Mathematical models, Sand, Clay, Accelerations.

Dynamic load testing of piles is used to determine the behavior at working load and beyond. For impact forces up to 30 MN equipment with a free fall ram weight of 10 tons is used. The impact induced strains and accelerations are measured at the pile top. A static load settlement curve is computed by the measured data by means of a mechanical-mathematical model. For several statically tested piles of different types with diameters up to 1.5 m and lengths up to 64 m in sand and clay layers the dynamic load test has been applied. The comparisons show the applicability of this economic test method for bored piles. (Author's abstract)
W90-00262

RUBBER WATERTIGHT FACINGS FROM TIRE PRODUCTION WASTES.
V. V. Aleksandryan, B. K. Lalazarov, and R. A. Alaverdyan.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 703-704, June 1989. 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 40-41, December, 1988.

Descriptors: *Reservoirs, *Reservoir linings, *Seepage, *Seepage control, Construction, Strength, Thermal stability, Permeability, Tire production wastes.

Control of seepage losses from water bodies and reservoirs is a continuing problem in water management construction. The possibility of using sheets made from tire production wastes as watertight facings has been investigated in regard to the physical, mechanical, chemical, technological, and service properties of the material. In order to solve a number of problems and to test the proposed material, an artificial water body with a depth of 2 m was faced with sheets. The facing was carried out by: leveling the base; unrolling and spreading the rolls along the bottom and slopes of the water body; applying the cement along the edges of the sheets on the overlap width, rolling the joint; and covering the facing with a protective soil layer. The results of the laboratory and field tests indicate the proposed material is suitable as a watertight facing. Facings of rubber tire production wastes are water stable, impermeable, sufficiently strong, elastic, frost-resistant, heat-resistant, and stable in aggressive and biological media. Sheets with a thickness of 0.2-0.3 cm completely meet the requirements imposed on roll materials used in watertight coatings. (White-Reimer-PTT)
W90-00790

POLYNOMIAL REGRESSION TO FORECAST EARTH DAM PIEZOMETER LEVELS.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W90-00880

8I. Fisheries Engineering

EFFECT OF WATER QUALITY ON SURVIVAL OF LAHONTAN CUTTHROAT TROUT EGGS IN THE TRUCKEE RIVER, WEST-CENTRAL NEVADA AND EASTERN CALIFORNIA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 5C.
W90-00222

ATLANTIC SALMON (SALMO SALAR) SMOLT PRODUCTION IN A NEWFOUNDLAND RIVER SYSTEM CHARACTERIZED BY LACUSTRINE HABITAT.
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
M. F. O'Connell, and E. G. M. Ash.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 7, No. 1, p 73-82, 1989. 4 fig, 1 tab, 26 ref.

Descriptors: *Salmon, *Smolt, *Spawning, *Lacustrine environment, Aquatic habitats, Productivity, Morphometry, Newfoundland.

Anadromous Atlantic salmon smolt production was determined for a portion of an insular Newfoundland river system consisting almost entirely of lacustrine environment. Production attributable to lacustrine habitat was estimated to be 10.1 smolts/ha. This represents the first such determination for a naturally spawning population of anadromous Atlantic salmon for insular Newfoundland. It is not known, however, if this value represents production at carrying capacity. There are probably differences in productivity among lakes resulting from differences in morphometry, especially in relation to the amount of shoreline littoral area available. Inter-lake comparisons of smolt production expressed in terms of total surface area could be misleading. Further research is required to define production in terms of the relative contribution of different lentic areas. Also, annual variation in production requires further assessment. (Author's abstract)
W90-00407

POPULATION DYNAMICS OF UNEXPLOITED LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) IN ONE EXPERIMENTALLY FERTILIZED LAKE AND THREE EXPLOITED LAKES.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. H. Mills, and S. M. Chalanchuk.
Finnish Fisheries Research FNFRAK, Vol. 1988, No. 9, p 145-153, 1988. 5 fig, 2 tab, 23 ref.

Descriptors: *Eutrophication, *Whitefish, *Fish populations, *Population dynamics, *Lake fisheries, *Fertilization, Phosphorus, Nutrients, Growth, Experimental Lakes Area, Ontario, Canada.

Unexploited lake whitefish populations were studied in 4 lakes at the Experimental Lakes Area, northwestern Ontario. One lake was divided into halves and each half was fertilized with a different combination of nutrients. The lake whitefish population in each basin was studied during 8 yr of fertilization with phosphorus, nitrogen, and carbon and 3 yr post-fertilization. The fish populations in 3 other lakes were exploited at rates varying from 26-63%. Lake whitefish growth increased in one fertilized basin and in 2 exploited lakes. Recruitment increased in all exploited lakes and in one fertilized basin. (Author's abstract)
W90-00611

PROPOSED BIOLOGICAL MANAGEMENT OF MYSIS RELICTA IN COLORADO LAKES AND RESERVOIRS.
Colorado Div. of Wildlife, Grand Junction.
P. L. Martinez.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 1-11, Winter 1989. 1 fig, 4 tab, 91 ref.

Descriptors: *Limnology, *Reservoir fisheries, *Lake fisheries, *Fish food organisms, *Shrimp, Predation, Trout, Kokanee, Sculpin, Colorado.

The opossum shrimp Mysis relicta has been introduced into many lakes and reservoirs outside its native range to supplement the prey bases for fish. Colorado has received more introductions of the mysid than any other state or province in western North America, but not all of these introductions have been beneficial or innocuous. Mysid predation on zooplankton, particularly cladocerans, has resulted in diminished food for some fishes, especially for planktivores such as the kokanee Oncorhynchus nerka and small trout Oncorhynchus spp. Few fishes forage on the often abundant populations of introduced mysids. Management options are limited in lakes where M. relicta competes for,

or has eliminated, the large zooplankters eaten by fish. The mysid has shown enough vagility to expand its nonnative range and may harm fisheries in waters that it enters. Because its eradication is not now feasible, the development of strategies to control or benefit from established mysid populations is warranted. Biological controls appear most feasible. Amphipods and fishes that have the potential to control or benefit from nuisance mysids through competition or predation are candidates for introduction. Of the 13 species examined, the deepwater sculpin Myoxocephalus thompsoni was the first choice for introduction into waters containing established mysids. This choice was based on its potential to either control mysid numbers or channel mysid production to predators with little or no adverse effects on the rest of the community. (Author's abstract)
W90-00614

PROPORTIONS OF HATCHERY- AND NATURALLY PRODUCED STEELHEAD SMOLTS MIGRATING PAST ROCK ISLAND DAM, COLUMBIA RIVER, WASHINGTON.
Public Utility District No. 1 of Chelan County, Wenatchee, WA.
C. M. Peven, and S. G. Hays.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 53-59, Winter 1989. 2 fig, 4 tab, 19 ref.

Descriptors: *Salmon, *Smolt, *Fish migration, *Columbia River, *Fish hatcheries, *Fish management, Mortality, Survival, Spawning, Fish eggs, Washington.

Proportions of hatchery- and naturally produced fish contributing to the outmigrant run of steelhead smolts Oncorhynchus mykiss (formerly Salmo gairdneri) were estimated from data collected at the Rock Island Dam bypass trap between 1 April and 30 June 1986. Hatchery fish, which averaged 28 mm longer than naturally produced fish, made up 72.5% of the run. Two methods were used to estimate the total run size. One was the 'life-history' method based on the number of spawning adults and survival rates; the other was the Peterson mark-recapture method in which hatchery fish with clipped adipose fins formed the marked group. The two resulting estimates were 904,689 and 904,729 fish, respectively. Sensitivity analyses were performed on variables that affected the natural production and total run size estimates. The analysis suggested that estimates of mortality related to dam passage and egg-to-smolt survival have the greatest effect on the run size estimations. (Author's abstract)
W90-00615

EFFECTS OF FLOW AND WEIR DESIGN ON THE PASSAGE BEHAVIOR OF AMERICAN SHAD AND SALMONIDS IN AN EXPERIMENTAL FISH LADDER.
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
B. Monk, D. Weaver, C. Thompson, and F. Ossiander.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 60-67, Winter 1989. 4 fig, 3 tab, 10 ref.

Descriptors: *Fish passages, *Fish ladders, *Weirs, *Flow characteristics, *Dam design, *Shad, *Salmon, John Day Dam, Columbia River, Washington.

During the 1960s, as more dams went into full operation on the Columbia River, it was discovered that the passage of American shad Alosa sapidissima was restricted or completely blocked through the regulating sections of some of the fish ladders. To study the problem, a full-scale laboratory model of 6 pools of the regulating section of the fish ladders at John Day Dam was built. American shad, chinook salmon Oncorhynchus tshawytscha, sockeye salmon O. nerka, and steelhead O. mykiss (formerly Salmo gairdneri) were counted and timed through various weir designs at different heads. American shad oriented toward surface flows, tending to reject submerged orifices as shallow as 2 m. The amount of time spent in the ladder by shad depended on the head between pools. The species of salmonids tested were not significantly impeded by any of the weir designs or head differentials. The results of these studies were used to develop new design criteria for the regulating sections of fish ladders. These criteria have been used in modifications of existing structures and in the design of new facilities. (Author's abstract)
W90-00616

POPULATION SIZE AND STATUS OF THE RAZORBACK SUCKER IN THE GREAT RIVER BASIN, UTAH AND COLORADO.
Fish and Wildlife Service, Vernal, UT. Colorado River Fishes Project.
S. H. Lanigan, and H. M. Tyus.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 68-73, Winter 1989. 2 fig, 2 tab, 16 ref.

Descriptors: *Sucker, *Fish populations, *Population dynamics, Green River, Utah, Colorado, Dams, Canyons.

The status of the razorback sucker Xyrauchen texanus in the Green River, Utah, was evaluated with capture-recapture data collected from 1980-88. The razorback sucker population in the upper Green River (river kilometers 282-555) was estimated at 948 fish (95% confidence interval, 758-1138), based on a total of 410 fish captured (68 recaptured). Razorback sucker in the lower Green River (km 0-211) were extremely rare; their numbers were too small (13 fish captured, 1 recaptured) to allow a reliable population estimate. Gray and lower Desolation canyons separated the upper and lower Green River razorback sucker populations. These canyons and a low diversion dam appeared to be barriers to fish movement. The absence of the razorback sucker in Gray and lower Desolation canyons (km 211-282) suggested a lack of suitable habitat. The Green River supports the largest known population of razorback suckers among the species' native riverine habitats. However, low population density and recruitment, as well as habitat alteration, mandate increased research and management efforts to save this population. (Author's abstract)
W90-00617

PUMPING ALKALINE GROUNDWATER TO RESTORE A PUT-AND-TAKE TROUT FISHERY IN A STREAM ACIDIFIED BY ATMOSPHERIC DEPOSITION.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
C. J. Gagen, W. E. Sharpe, D. R. DeWalle, and W. G. Kimmel.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 1, p 92-100, Winter 1989. 2 fig, 5 tab, 33 ref.

Descriptors: *Water pollution treatment, *Stream fisheries, *Trout, *Acid rain effects, *Alkaline water, *Groundwater, *Fish migration, Water chemistry, Acidity, Aluminum, Hydrogen ion concentration, Wells, Runoff, Sport fishing, Linn Run, Pennsylvania.

The purpose of this study was to pump alkaline groundwater into Linn Run in southwestern Pennsylvania to neutralize acidity, reduce dissolved aluminum concentrations, and protect stocked brown trout Salmo trutta and brook trout Salvelinus fontinalis during the springs of 1985-86. A regression model was used to estimate the groundwater volume needed to maintain predetermined stream pH levels for a given streamflow. Equal numbers of brook and brown trout were stocked in a treatment stream section influenced by the wells and a naturally alkaline downstream reference section before and during the fishing season each year. Groundwater addition increased mean stream pH from 4.9 upstream of the wells to 6.0 in the treatment section and reduced mean dissolved aluminum from 0.36 mg/L to 0.03 mg/L above and below the wells, respectively. A large runoff episode following the 1985 preseason stocking overwhelmed the capacity of the wells to neutralize Linn Run, causing at least 25% mortality and reducing the catch rate of brown trout in the treatment section. No mortality of caged trout occurred in the treatment section except during this large runoff event. However, mortality was rapid for caged trout upstream of the wells; median survival times were 67 and 29 h for brook and brown trout, respectively. Otherwise, angler catch rates and trout harvest were not significantly different between the treated and reference sections. Electrofishing surveys revealed greater downstream than upstream movement of stocked trout, which may indicate a response to water chemistry. Alkaline groundwater additions also caused an increase in the density of native brook trout in the treatment section via upstream migration from downstream refuges influenced by groundwater. (Author's abstract)
W90-00618

DISTRIBUTION AND ABUNDANCE OF FISHES ASSOCIATED WITH SUBMERSED AQUATIC PLANTS IN THE POTOMAC RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W90-00619

QUALITY OF THE GROUND WATER AROUND THE LOWER REACHES OF THE MIYA RIVER.
National Research Inst. of Aquaculture, Mie (Japan).
For primary bibliographic entry see Field 2F.
W90-00649

FOOD OF FORAGE FISHES IN WESTERN LAKE ERIE, 1975-76.
Fish and Wildlife Service, Sandusky, OH. Biological Station.
For primary bibliographic entry see Field 2H.
W90-00841

AGE VERIFICATION OF WALLEYES FROM LAKE OF THE WOODS, MINNESOTA.
Minnesota Univ., St. Paul. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W90-00847

FACTORS AFFECTING RECRUITMENT AND MORTALITY RATES OF RAINBOW SMELT (OSMERUS MORDAX) IN LAKE ERIE, 1963-85.
Ontario Ministry of Natural Resources, Maple. Fisheries Branch.
For primary bibliographic entry see Field 2H.
W90-00852

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1987.
Department of Primary Industry, Canberra (Australia).
1988. 159p.

Descriptors: *Bibliographies, *Australia, *Water resources institutes, Research priorities, Information exchange, Data storage and retrieval.

This 1987 edition of an annual publication incorporates about 1000 summaries of water related research organizations. Research projects are grouped according to broad subject categories, and within these are listed in alphabetical order by project title. Two indexes allow retrieval by the names of members of the research team and the organizations carrying out or sponsoring the research, and by subject, using terms from AQUALINE thesaurus and additional Australian terms. Information included in the publication is taken

from the Australian computerized data base, STREAMLINE. (Author's abstract)
W90-00146

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1988.
Department of Primary Industry, Canberra (Australia).
1989. 163p.

Descriptors: *Bibliographies, *Australia, *Water resources institutes, Research priorities, Information exchange, Data storage and retrieval.

This 1988 edition of an annual publication incorporates about 1000 summaries of water related research organizations. Research projects are grouped according to broad subject categories, and within these are listed in alphabetical order by project title. Two indexes allow retrieval by the names of members of the research team and the organizations carrying out or sponsoring the research, and by subject, using terms from AQUALINE thesaurus and additional Australian terms. Information included in the publication is taken from the Australian computerized data base, STREAMLINE. (Author's abstract)
W90-00147

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1987.
Department of Primary Industry, Canberra (Australia).
For primary bibliographic entry see Field 9C.
W90-00146

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1988.
Department of Primary Industry, Canberra (Australia).
For primary bibliographic entry see Field 9C.
W90-00147

10D. Specialized Information Center Services

BUREAU'S DATA BANK--HOW IT WORKS.
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 7C.
W90-00119

REMISS: RESEARCH MANAGEMENT INFORMATION SYSTEM.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
N. R. Sumner, and A. A. Curtis.
Technical Memorandum 88/15, December 1988. 74p, 2 tab, 8 ref, 5 append.

Descriptors: *Management information systems, *Computer programs, *Management planning, *Information systems, *Database, *Data storage and retrieval, Information retrieval, Information exchange, Research priorities.

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W90-00256

10F. Preparation Of Reviews

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W90-00092

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W90-00098

SUBJECT INDEX

ABSORPTION

Improvements in Soil Absorption Trench Design.
W90-00665 5D

Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

ACID LAKES

'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

ACID MINE DRAINAGE

Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

ACID MINE WATER

Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

ACID RAIN

Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Save the Rain.
W90-00066 5G

Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

Florida Acid Deposition Research Program.
W90-00068 5C

Acid Deposition Research and Policy.
W90-00069 5B

Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

Acid Deposition Program: Scope of Work.
W90-00072 5B

Wisconsin Acid Deposition Program.
W90-00073 5G

Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

Acid Rain: Delays and Management Changes in the Federal Research Program.
W90-00138 5B

Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

Review of Acid Rain Models for Europe.
W90-00233 5B

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Biologisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Effects of Acid Deposition on the Catchment Area of Lake Marsjoen-Basic Study (Happaman Laskeuman Vaikutuksista Marsjon-Jarven Valuma-Alufella Pruselvitys).
W90-00276 5C

Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

ACID RAIN EFFECTS

Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Florida Acid Deposition Research Program.
W90-00068 5C

Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

ACID RAIN EFFECTS

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Acid Precipitation: Effects on Fresh Water Ecosystems, January, 1978-September 1988: Citations from the Life Sciences Collection Database.
W90-00192 5C

Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

ACID STREAMS

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

ACIDIC SOILS

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

ACIDIC WATER

Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Biologisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

ACIDIFICATION

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

ACIDITY

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

ACTINIDE ELEMENTS

Actinide Behavior in Natural Waters.
W90-00558 5B

ACTIVATED CARBON

Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

ACTIVATED SLUDGE

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

Development and Design of Sludge Freezing Beds.
W90-00661 5E

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

ACTIVATED SLUDGE PROCESS
Demonstration and Evaluation of the Captor Process for Sewage Treatment.
W90-00254 5D

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Get Control of Your Activated Sludge Process.
W90-00667 5D

Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

ADAPTATION
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

ADMINISTRATIVE AGENCIES
Florida Acid Deposition Research Program.
W90-00068 5C

EPA: Ground Water Handbook.
W90-00087 5G

Bureau's Data Bank--How It Works.
W90-00119 7C

ADRIATIC SEA
Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

ADSORBENTS
Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

ADSORPTION
Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

ADVANCED WASTEWATER TREATMENT
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

ADVECTION
Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

AERATED LAGOONS
Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

AERATION
Gassing of Biosuspensions in Bubble Column and Loop Reactors (Begasung von Biosuspensionen in Blasensaeuien und Schiaufenreaktoren).
W90-00190 5D

Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

Spinning Air Blasts Operating Costs.
W90-00668 5D

Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

Air-Water Gas Transfer in Open Channels.
W90-00944 2E

AERATION ZONE
Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Simple Empirical Model of Root Water Uptake.
W90-00355 2I

AEROBIC DIGESTION
Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

AEROBIC TREATMENT
Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

AGGRADATION
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

AGGRADING RIVERS
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

AGRICULTURAL ENGINEERING
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

Economic Impact of Micro Catchment Development.
W90-00882 4A

Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

Solute Movement Through Root-soil Environment.
W90-00885 2I

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

Research Needs in Irrigation and Drainage--1989.
W90-00893 3F

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

AGRICULTURAL HYDROLOGY
Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Minimum Data Sets: Hydrological Applications.
W90-00103 3F

Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

Decision Making Using a Drought Severity Index.
W90-00110 6A

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

AGRICULTURAL RUNOFF
Agricultural Nonpoint Source Pollution: Model Selection and Application.
W90-00001 5B

Review of Hydrologic and Water Quality Models Used for Simulation of Agricultural Pollution.
W90-00002 5B

Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

AGRICULTURAL WATERSHEDS
Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Geology and Survival on the Snake River Plain.
W90-00335 5G

AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

AGRICULTURE
Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

Detection of Moisture Stress by Indicator Plots--A Simulation.
W90-00574 2I

Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

AGRONOMY
Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

AIR-EARTH INTERFACES
Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

AIR FLOTATION
Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

AIR POLLUTION
Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

AIR POLLUTION CONTROL
Save the Rain.
W90-00066 5G

Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

Acid Deposition Research and Policy.
W90-00069 5B

Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

Acid Deposition Program: Scope of Work.
W90-00072 5B

Wisconsin Acid Deposition Program.
W90-00073 5G

What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

AIR POLLUTION EFFECTS
Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

AIR POLLUTION SOURCES
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

AIR-WATER INTERFACES
Simulation of Wind-induced Water Currents.
W90-00632 2H

Air-Water Gas Transfer in Open Channels.
W90-00944 2E

ALABAMA
Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

ALACHLOR
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

ALASKA
Glaciers and Glaciology of Alaska.
W90-00077 2C

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

ALCOHOLS
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

ALDRIN
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

ALFALFA
Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

ALGAE
Algae and Associated Aquatic Bacteria.
W90-00172 5G

Seasonal Variation in Uptake and Retention of Cadmium in the Seaweed Zostera marina L. from the Kiel Fjord (Western Baltic Sea) (Jahresgang, Aufnahme und Verbleib von Cadmium im Seegras Zostera Marina L. aus der Kieler Forde (Westliche Ostsee)).
W90-00260 5B

Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

Central Asian Irrigation Canals and some Aspects of their Algal Flora.
W90-00408 2H

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Flow Cytometry for Algal Studies.
W90-00903 7B

ALGAL GROWTH
Central Asian Irrigation Canals and some Aspects of their Algal Flora.
W90-00408 2H

ALGORITHMS
Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

ALIPHATIC HYDROCARBONS
Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

ALKALINE SOILS
Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

ALKALINE WATER
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

ALKANES
Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

ALKYLBENZENE SULFONATES
Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

ALLUVIAL AQUIFERS
Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

ALLUVIAL CHANNELS
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

ALLUVIAL FANS
Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

ALPINE REGIONS
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

ALUM
Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

ALUMINUM
Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

ALUMINUM

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

AMINO ACIDS

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

AMMONIA

Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

AMMONIUM

Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

AMPHIPODS

Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

ANAEROBIC BACTERIA

Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

ANAEROBIC CONDITIONS

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

ANAEROBIC DIGESTION

Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

Vacuum Operation for Overloaded Anaerobic Treatment Systems.
W90-00754 5D

Effects of Thermal Pretreatment of Sewage Sludge on Anaerobic Digestion.
W90-00755 5D

Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

ANAEROBIC FILTERS

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

ANAEROBIC LAGOONS

Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

ANIMAL WASTES

Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

ANISOTROPY

Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

ANTIFOULANTS
Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

ANTIMONY
Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

APHOTIC ZONE
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

AQUACULTURE
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

AQUATIC ANIMALS
Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

AQUATIC BACTERIA
Algae and Associated Aquatic Bacteria.
W90-00172 5G

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

AQUATIC ENVIRONMENT
Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

Microorganisms and the Aquatic Environment.
W90-00724 2H

Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

AQUATIC FUNGI
Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

AQUATIC HABITATS
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

AQUATIC INSECTS
Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

AQUATIC LIFE
Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

AQUATIC PLANTS
Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthesis of Salt Marsh Species.
W90-00605 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

AQUATIC POPULATIONS
Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

AQUATIC PRODUCTIVITY
Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

AQUATIC WEED CONTROL
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

AQUATIC WEEDS
Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

AQUEDUCTS
Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6G

AQUIFER SYSTEMS
Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

AQUIFER TESTING
Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

AQUIFER TESTS
Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

AQUIFERS
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Surficial and Subsurface Distribution of Aquifer Sediments at the Bemidji, Minnesota, Research Site.
W90-00033 2F

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00227 2F

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

Modelling of Large-Scale Heat and Contaminant Transport in Groundwater: Report of Activities 1986/87 (Modellerung des Grossraeumigen Waermetransports und Schadstofftransports im Grundwasser: Taetigkeitsbericht 1986/87).
W90-00269 2F

Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

ARCHAEOLOGY
Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 1.
W90-00081 6G

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 2.
W90-00082 6G

Homesteading in the Depression: A Study of Two Short-lived Homesteads in the Harquahala Valley, Arizona.
W90-00131 6G

Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6G

Historical Archaeological Investigations at Dam Construction Camps in Central Arizona: Second Annual Report.
W90-00149 6G

Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

ARCTIC
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

ARGENTINA
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

ARID CLIMATES
Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

ARIZONA
Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 1.
W90-00081 6G

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 2.
W90-00082 6G

Homesteading in the Depression: A Study of Two Short-lived Homesteads in the Harquahala Valley, Arizona.
W90-00131 6G

Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

ARKANSAS RIVER
Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

AROMATIC COMPOUNDS
Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

ARSENIC
Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Arsenic.
W90-00169 5G

ARTESIAN PRESSURE
Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

ARTESIAN WELLS
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

ARTIFICIAL RECHARGE
Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

ASIA
Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

ASPHALTIC CONCRETE
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

ATMOSPHERIC WATER
Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

ATOMIC ABSORPTION SPECTROPHOMETRY
Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

ATOMIC ABSORPTION SPECTROPHOTOMETRY
Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

ATOMIC ABSORPTION SPECTROSCOPY
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

AUSTRALIA
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

Water Research in Australia: Current Projects 1987.
W90-00146 9C

Water Research in Australia: Current Projects 1988.
W90-00147 9C

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

AUTOMATION
Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

AUTOMOTIVE INDUSTRY
Wastewater Management in the Automobile Industry.
W90-00769 5D

AVALANCHE DAMS
Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

AVALANCHES
Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

BACTERIA
Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

BACTERIAL ANALYSIS
Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

Electrode system for Determination of Microbial Cell Populations in Polluted Water.
W90-00397 5A

Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

BACTERIAL PHYSIOLOGY
Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

BACTERIAL TOXINS
Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

BALTIC SEA
Monitoring of the Sea: Report on the Activities in 1984 (Ueberwachung des Meeres: Bericht fuer das Jahr 1984).
W90-00263 5A

Monitoring of the Sea: Report on the Activities in 1983 (Ueberwachung des Meeres: Bericht fuer das Jahr 1983).
W90-00264 5A

Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

BANGLADESH
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

BANK EROSION
Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

BANK PROTECTION
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

BANK STABILIZATION
Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

BARRIERS
Wettable Porous Plastic for Use as a Porous Barrier in Soil Hydraulic Studies.
W90-00389 2G

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

BASALTS
Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

BASELINE STUDIES
Analytical Chemistry for Environmental Sciences.
W90-00542 5A

BATHYPHOTOMETRY
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

BATON ROUGE
Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

BED LOAD
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

BED-LOAD DISCHARGE
Modification of Bedload Transport Capacity in Braided Rivers (Note)
W90-00936 2J

BENTHIC ENVIRONMENT
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

BENTHIC FLORA
Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

BENTHOS
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

BENTONITE
Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

BENTONITE *BACTERIA
Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

BENZENES
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

BENZOFLUORANTHENE
Health and Environmental Effects Profile for Benzo(k)Fluoranthene.
W90-00236 5C

BERMUDA
Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

BERYLLIUM
Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

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W90-00146 9C

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W90-00178 5E

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W90-00192 5C

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W90-00256 5A

BICARBONATES
Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

BIOACCUMULATION
Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Seasonal Variation in Uptake and Retention of Cadmium in the Seaweed Zostera marina L. from the Kiel Fjord (Western Baltic Sea) (Jahresgang, Aufnahme und Verbleib von Cadmium im Seegras Zostera Marina L. aus der Kieler Forde (Westliche Ostsee)).
W90-00260 5B

Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

BIOASSAY

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

BIOAVAILABILITY

Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

BIOCHEMICAL OXYGEN DEMAND

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

BIOCHEMISTRY

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

BIODEGRADATION

Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Health and Environmental Effects Profile for Benzo(k)Fluoranthene.
W90-00236 5C

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

BIODEGRADATION

Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

BIOFILM REACTORS

Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

BIOFILMS

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

BIOGAS

Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

BIOINDICATORS

Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Flow Cytometry for Algal Studies.
W90-00903 7B

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

BIOLOGICAL MAGNIFICATION

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

BIOLOGICAL SAMPLES

Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

BIOLOGICAL TREATMENT

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

BIOLOGICAL WASTEWATER TREATMENT

Gassing of Biosuspensions in Bubble Column and Loop Reactors (Begasung von Blosuspensionen in Blasensaeuien und Schiaufenreaktoren).
W90-00190 5D

Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Electrobiological Wastewater Treatment.
W90-00529 5D

Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

Role of Acetate in Denitrification and Biological Phosphate Removal in Modified Bardenpho Systems.
W90-00780 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

BIOMASS
Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

BIOREMEDIATION
In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

BIOSYNTHESIS
Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

BIOTRANSFORMATION
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

BIOTURBATION
Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

BLACK CREEK AQUIFER
Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

BOATING
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

BOREHOLES
Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

BOSTON HARBOR
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

BOTTOM SAMPLING
Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

BOTTOM SEDIMENTS
Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

BOUNDARY CONDITIONS
Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

BRACKISH WATER
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

BRAIDED STREAMS
Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

BRANCH SEWERS
Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

BRAZIL
Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

BREAKWATERS
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

BUFFER ZONES
Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

BULKING SLUDGE
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

CADDISFLIES
Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

CADMIUM
Seasonal Variation in Uptake and Retention of Cadmium in the Seaweed Zostera marina L. from the Kiel Fjord (Western Baltic Sea) (Jahresgang, Aufnahme und Verbleib von Cadmium im Seegras Zostera Marina L. aus der Kieler Forde (Westliche Ostsee)).
W90-00260 5B

Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

Cadmium Soil Sorption at Low Concentrations: VII, Effect of Stable Solid Waste Leachate Complexes.
W90-00802 5B

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

CALCASIEU LAKE
Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

CALCASIEU RIVER
Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

CALCITE
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

CALCIUM
Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

CALCIUM CARBONATE
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

CALIBRATIONS
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

CALIFORNIA
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Streamflow, Sediment Transport, and Nutrient Transport at Incline Village, Lake Tahoe, Nevada, 1970-73.
W90-00219 2E

Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

Diversion Project Alleviates Saltwater Intrusion.
W90-00798 5G

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

CANADA
Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

CANALS
Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

CANOPY
Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

CARBOFURAN
Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

CARBOHYDRATES
Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

CARBON
Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

CARBON CYCLE
Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

CARBON DIOXIDE
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

CARP
Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

CATALYSTS
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

CATCHMENT AREA
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

CATCHMENT AREAS
Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

CATCHMENT BASINS
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

CATFISH
Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

CATION EXCHANGE
Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

CATIONS
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

CENTRIFUGATION
Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

CESIUM
Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

CHANGJIANG RIVER
Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

CHANNEL EROSION
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

CHANNEL FLOW
Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

CHANNEL MORPHOLOGY
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

CHANNELING
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

CHELATING AGENTS
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

CHELATION
Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

CHEMICAL ANALYSIS
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Determination of Fluoride Ions in Water by Conductometric Titration with Lanthanum Nitrates (Determinacao de Ions Fluoreto em Aguas, por Titulacao Condutometrica com Nitrato de Lantanio).
W90-00274 5A

Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in

Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

Analytical Chemistry for Environmental Sciences.
W90-00542 5A

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

CHEMICAL COMPOSITION

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

CHEMICAL DEGRADATION

Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

CHEMICAL OXYGEN DEMAND

Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

CHEMICAL PRECIPITATION

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

CHEMICAL REACTIONS

Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

CHEMICAL SPECIATION

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

CHEMICAL TREATMENT

Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

CHEMICAL WASTES

Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

CHEMICAL WASTEWATER

Wastewater Management in the Automobile Industry.
W90-00769 5D

New Method of Design of Steam-Distillation Treatment of Wastewater.
W90-00837 5D

CHEMISTRY OF PRECIPITATION

Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

CHERNOBYL
Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

CHESAPEAKE BAY
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

CHINA
Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

CHLAMYDOMONAS
Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

CHLORELLA
Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

CHLORIDES
Chloride.
W90-00166 5G

CHLORINATED HYDROCARBONS
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

CHLORINATION
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

Aqueous Chlorination of Permethrin.
W90-00914 5F

CHLOROANILINES
Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

CHLOROBENZENES
Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

CHLOROPHYLL A
Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

CHLOROPHYTA
Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

CHLORPYRIFOS
Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

CHROMATOGRAPHY
Chromatography for Water Pollution Analysis, January, 1977-October, 1988: Citations from the Energy Data Base.
W90-00256 5A

Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

CHROMIUM
Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

CITRUS FRUITS
Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

CLADOCERANS
Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

CLADOPHORA
Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

CLAMS
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

CLAY LOAM
Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

CLAYS
Clay Mineralogy of Sediments Associated with a Plume of Creosote-Contaminated Ground Water.
W90-00023 2K

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

CLEANUP OPERATIONS
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

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W90-00183 5G

Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

CLEAR-CUTTING
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

CLIMATES
Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

CLIMATIC DATA
Estimating Climatic Data.
W90-00105 7C

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Bureau's Data Bank--How It Works.
W90-00119 7C

Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

CLIMATOLOGY
Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Estimating Climatic Data.
W90-00105 7C

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

CLOGGING
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

CLOUD LIQUID WATER
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

CLOUDS
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

COAGULATION
Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

COAL GASIFICATION
Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

COAL GASIFICATION WASTES
Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

COAL MINE EFFECTS
Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

COAL MINES
Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

COAL MINING
Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

COASTAL AQUIFERS
Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

COASTAL WATERS
Heavy Metal Concentrations in the Mediterranean Estuarine Regions of the Rhone, Ebro, Po, and Arno Rivers (Ermittlung der Aktuellen Schwermetallbelastungen in den Mittelmeeraestuarien von Rhone, Ebro, Po und Arno).
W90-00273 5B

Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

COBALT
Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

COBALT RADIOISOTOPES
Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

COHESIVE SEDIMENTS
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

COLD REGIONS
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

Nitrogen Removal Works Year-Round.
W90-00552 5D

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Development and Design of Sludge Freezing Beds.
W90-00661 5E

Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

COLIFORMS
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

COLOR
Turbidity and Color.
W90-00164 5G

COLOR REMOVAL
Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

COLORADO
Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

COLORADO RIVER
Glen Canyon Environmental Studies: Executive Review Committee Final Report.
W90-00095 6G

Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

COLORIMETRY
Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

COLUMBIA RIVER
Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

COMBINED SEWER OVERFLOWS
Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

COMMERCIAL FISHING
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

COMPARISON STUDIES
Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

COMPREHENSIVE PLANNING
Percival Creek Corridor Plan.
W90-00326 6B

COMPUTER MODELS
Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

COMPUTER PROGRAMS
REMISS: Research Management Information System.
W90-00129 10D

Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Analytical Groundwater Modeling: Flow and Contaminant Migration.
W90-00162 2F

Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

COMPUTERS
Advanced Information System of Waterworks, (in Japanese).
W90-00255 5F

CONCENTRATION TIME
Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

CONCRETE ADDITIVES
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

CONCRETE DAMS
Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

CONCRETE MIXES
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

CONCRETES
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

CONDUCTIVITY
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

CONE PENETROMETERS
Cone Penetration Testing for Evaluating the Liquefaction Potential of Sands.
W90-00125 8D

CONFERENCES
Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984.
W90-00052 5B

CONJUNCTIVE USE
Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

CONSERVATION
Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

CONSTRUCTION MATERIALS
Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

CONTACT BEDS
Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

CONVEYANCE STRUCTURES
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

Engineering Approach to Waterline Thrust Restraint.
W90-00795 8A

COPEPODS
Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

COPPER
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Removal of Copper From Solution Using Moss.
W90-00496 5D

Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

CORES
Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectroscopic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tiefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissionsspektrometrischer Ver-fahren).
W90-00186 5A

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

CORN
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

COST ANALYSIS
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

COST-BENEFIT ANALYSIS
Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

Flooding and the Quantification of 'Intangibles'.
W90-00925 6A

COSTS
Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

CRABS
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

CREOSOTE
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Reexamination of the Occurrence and Distribution of Creosote Compounds in Ground Water.
W90-00025 5B

Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

CROCODILES
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

CROP PRODUCTION
Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

CROP YIELD
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Solute Movement Through Root-soil Environment.
W90-00885 2I

CROPS
Detection of Moisture Stress by Indicator Plots--A Simulation.
W90-00574 2I

CRUSTACEANS
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

CULTIVATION
Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

CULTURE MEDIA
Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

CULTURING TECHNIQUES
Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

CURRENT METERS
Observations of Concurrent Drifting Buoy and Current Meter Measurements in Lake Michigan.
W90-00839 2H

CUTOFFS
Cutoff Wall Construction to Upgrade Mud Mountain Dam.
W90-00155 8E

CYANIDE
Cyanide.
W90-00170 5G

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

CYANOPHYTA
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

CYCLING NUTRIENTS
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

CYTOMETRY
Flow Cytometry for Algal Studies.
W90-00903 7B

DAIRY INDUSTRY
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

DAM CONSTRUCTION
Historical Archaeological Investigations at Dam Construction Camps in Central Arizona: Second Annual Report.
W90-00149 6G

Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

DAM DESIGN
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

DAM EFFECTS
Glen Canyon Environmental Studies: Executive Review Committee Final Report.
W90-00095 6G

Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

DAM SEEPAGE
Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

DAM STABILITY
Cutoff Wall Construction to Upgrade Mud Mountain Dam.
W90-00155 8E

DAMS
Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

Kentucky, May 1984: Spillway Performance Report.
W90-00157 8A

Floodwater Retarding Structure No. 4, Misteguay Creek, Michigan: Spillway Performance Report for Flow of September 1985.
W90-00158 8A

Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

DAPHNIA
Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

DATA ACQUISITION

Field Data Acquisition Systems.
W90-00021 7B

Field Assessment of the Effects of Contaminants on Fishes.
W90-00083 5C

Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

DATA COLLECTIONS

Indiana Water Quality 1987: Monitor Station Records, Rivers and Stream.
W90-00079 5B

Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Minimum Data Sets: Hydrological Applications.
W90-00103 3F

Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Estimating Climatic Data.
W90-00105 7C

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Decision Making Using a Drought Severity Index.
W90-00110 6A

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Bureau's Data Bank--How It Works.
W90-00119 7C

Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

Indiana Water Quality 1986: Monitor Station Records--Rivers and Streams.
W90-00127 2E

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

Quality of Ground Water in Idaho.
W90-00202 2F

DATA INTERPRETATION

Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

Estimating Climatic Data.
W90-00105 7C

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Decision Making Using a Drought Severity Index.
W90-00110 6A

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

DATA PROCESSING

Advanced Information System of Waterworks, (in Japanese).
W90-00255 5F

Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

DATA STORAGE AND RETRIEVAL

REMISS: Research Management Information System.
W90-00129 10D

Advanced Information System of Waterworks, (in Japanese).
W90-00255 5F

Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

DATABASE

REMISS: Research Management Information System.
W90-00129 10D

DATABASES
Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

DDE
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

DDT
PCBs and DDT in Saginaw Bay White Suckers.
W90-00485 5B

DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

DECISION MAKING
Decision Making Using a Drought Severity Index.
W90-00110 6A

DECOMPOSITION
Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

DECONTAMINATION
Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

DEEP SEEPAGE
Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

DEEP WATER
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

DEEP WELLS
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

DEGRADATION
Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

DEHALOGENATION
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

DELAWARE
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

DELAWARE BAY
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

DELAWARE RIVER
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

DELTAS
Expectations for Water Level Deviations at the Delta Works: Zlerikzee (Netherlands), November 1981-February 1986 (Verwachtingen voor Water-Standsafwijkingen Deltawerken: Zierikzee November 1981-Februari 1986).
W90-00185 2L

Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

DENITRIFICATION
Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

Role of Acetate in Denitrification and Biological Phosphate Removal in Modified Bardenpho Systems.
W90-00780 5D

DENSITY CURRENTS
Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

DEPOSITION
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

DESERTS
Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

DESORPTION
Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

DETERGENTS
Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

DETOXIFICATION
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

DEVELOPING COUNTRIES
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

DEWATERING
Dewatering Behaviour of Sewage Sludge with Inorganic and Macro-Molecular Means of Flocculation (Entwaesserungsverhalten eines Faulschlammes mit Anorganischen und Makromolekularen).
W90-00272 5D

Development and Design of Sludge Freezing Beds.
W90-00661 5E

DIAGENESIS
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

DIATOMS
Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

DIESEL FUEL
In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

DIFFUSION
Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

DIFFUSIVITY
Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

DIGESTED SLUDGE
Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

Effects of Thermal Pretreatment of Sewage Sludge on Anaerobic Digestion.
W90-00755 5D

DIGESTER GAS
Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

DIKES
Hydraulic Calculations for Flow Under Dikes on Consolidated Beds (Untergrundhydraulische Berechnungen an Flussdeichen auf Bindigen Deckschichten).
W90-00257 2F

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

DIOXINS
Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

DIPERSION
Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

DISINFECTION
Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Investigations on Treatment of Wastewater and Sludge, Nitrification and Reduction of Phosphates in Lime Pre-precipitation with Subsequent Aerobic Stabilization (Untersuchungen zur Abwasser-und Schlamm-hygienisierung, Nitrifikation und Phosphatverminderung bei der Kalkvorfallung mit Nachfolgender aerober Stabilisierung).
W90-00258 5D

Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

Aqueous Chlorination of Permethrin.
W90-00914 5F

DISPERSANTS
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

DISPERSION
Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

DISSOLVED OXYGEN
Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

DISSOLVED SOLIDS
Total Dissolved Solids.
W90-00165 5G

Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

DISTILLATION
New Method of Design of Steam-Distillation Treatment of Wastewater.
W90-00837 5D

DISTRIBUTION
Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

DISTRIBUTION PATTERNS
Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

DIVERSION STRUCTURES
Diversion Project Alleviates Saltwater Intrusion.
W90-00798 5G

DNA
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

DOMESTIC WASTES
Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

DOMESTIC WATER
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

DRAINAGE
Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

DRAINAGE AREAS
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

DRAINAGE CANALS
Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

DRAINAGE DENSITY
Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

DRAINAGE EFFECTS
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

DRAINAGE PATTERNS
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

DRAINAGE PROGRAMS
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

Research Needs in Irrigation and Drainage--1989.
W90-00893 3F

DRAINAGE SYSTEMS
Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

DRAINAGE WATER
Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

DREDGING
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

DRILL HOLES
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

DRINKING WATER
Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs): 1987 Review of the Draft Final.
W90-00085 5G

Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

Point-of-Use/Point-of-Entry Systems for Removing VOCs from Drinking Water.
W90-00137 5F

Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources.
W90-00163 5G

Turbidity and Color.
W90-00164 5G

Total Dissolved Solids.
W90-00165 5G

Chloride.
W90-00166 5G

Magnesium.
W90-00167 5G

Sulfate.
W90-00168 5G

Arsenic.
W90-00169 5G

Cyanide.
W90-00170 5G

Lindane.
W90-00171 5G

Algae and Associated Aquatic Bacteria.
W90-00172 5G

Health Effects of Drinking Water Treatment Technologies.
W90-00177 5F

Heavy Metals in Drinking Water: Standards, Sources, and Effects, January, 1978-September, 1988: Citations from the Life Sciences Collection Database.
W90-00179 5F

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Determination of Fluoride Ions in Water by Conductometric Titration with Lanthanum Nitrates (Determinacao de Ions Fluoreto em Aguas, por Titulacao Condutometrica com Nitrato de Lantanio).
W90-00274 5A

Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

Overview of the MWRA Water Conservation Program.
W90-00652 3D

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

Drinking Water Standards and Risk Assessment.
W90-00922 5G

Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

DRIP IRRIGATION
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

DROUGHT
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Decision Making Using a Drought Severity Index.
W90-00110 6A

Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

Influence of the 1982-83 Drought on River Flows in Hawke's Bay.
W90-00932 2E

Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

DRY FARMING
Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

Homesteading in the Depression: A Study of Two Short-lived Homesteads in the Harquahala Valley, Arizona.
W90-00131 6G

DRY MATTER
Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

DYE RELEASES
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

DYES
Health and Environmental Effects Profile for Niagara Blue 4B.
W90-00247 5C

Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

DYNAMIC PROGRAMMING
Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

EARTH DAMS
Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

EARTHWORKS
Filtration Behaviour of Soil Filters (Filtrationsverhalten und Bemessung von Erdstoff-Filtern).
W90-00189 8D

ECHINODERMS
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

ECOLOGICAL DISTRIBUTION
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

ECOLOGICAL EFFECTS
Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

ECOLOGY
Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

ECONOMIC ASPECTS
Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Water and Wastewater Finance and Pricing.
W90-00176 5D

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

ECONOMIC DEVELOPMENT
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

ECONOMIC EVALUATION
Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

Economic Impact of Micro Catchment Development.
W90-00882 4A

ECONOMIC IMPACT
Economic Impact of Micro Catchment Development.
W90-00882 4A

ECOSYSTEMS
Developments in Ecological Modelling.
W90-00003 7C

Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

EDDIES
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

EELGRASS
Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

EFFLUENTS
Aquatic Pollution in the Far East.
W90-00739 5B

ELECTRICAL STUDIES
Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

ELECTROBIOLOGICAL WASTEWATER TREATMENT
Electrobiological Wastewater Treatment.
W90-00529 5D

ELECTROCHEMISTRY
Development and Investigation of a Process for the Electrochemical Treatment of Wastewater (Entwicklung und Untersuchung eines Verfahrens zur Elektrochemischen Aufbereitung von Abwasser).
W90-00268 5D

ELECTRODES
Electrode system for Determination of Microbial Cell Populations in Polluted Water.
W90-00397 5A

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

ELECTROMAGNETIC WAVES
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

ELECTRON ACCEPTORS
Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

EMBANKMENTS
Hydrologic Design for Riprap on Embankment Slopes.
W90-00084 8D

Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

ENDOSCOPY
Filtration Studied with Endoscopes.
W90-00419 5F

ENERGY
Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

ENERGY SOURCES
Rubber Heat Engine for Ground Water Irrigation in India.
W90-00291 3F

From Experimental to Large Tidal Power Stations (20th Anniversary of the Kislogubsk Tidal Power Station).
W90-00787 8C

Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

ENERGY TRANSFER
Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

ENGLAND
Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

ENRICHMENT
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

ENTERIC BACTERIA
Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

ENTRAINMENT
Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

ENVIRONMENTAL EFFECTS
Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

Side Effects of Water Resources Management.
W90-00160 6G

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

ENVIRONMENTAL ENGINEERING

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

ENVIRONMENTAL POLICY

Blueprint for the Environment: A Plan for Federal Action.
W90-00161 5G

Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

Percival Creek Corridor Plan.
W90-00326 6B

Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

ENVIRONMENTAL PROTECTION

Blueprint for the Environment: A Plan for Federal Action.
W90-00161 5G

Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

Percival Creek Corridor Plan.
W90-00326 6B

ENVIRONMENTAL QUALITY

Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

ENVIRONMENTAL TRACERS

Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

ENZYMES

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

EPHEMERAL LAKES

Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

EPIPHYTES

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

EPOXIDES

Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

EQUILIBRIUM

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

EROSION

Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Black Creek No. 53, Mississippi, May 1983: Spillway Performance Report.
W90-00156 8A

Kentucky, May 1984: Spillway Performance Report.
W90-00157 8A

Floodwater Retarding Structure No. 4, Misteguay Creek, Michigan: Spillway Performance Report for Flow of September 1985.
W90-00158 8A

Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

EROSION CONTROL

Spillway Performance Report, Mississippi, December 1982.
W90-00135 8B

Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

ESCHERICHIA COLI

Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

ESTERS

Health and Environmental Effects Profile for Phthalic Acid Esters (PAEs).
W90-00253 5C

ESTUARIES

Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

Heavy Metal Concentrations in the Mediterranean Estuarine Regions of the Rhone, Ebro, Po, and Arno Rivers (Ermittlung der Aktuellen Schwermetallbelastungen in den Mittelmeeresestuarien von Rhone, Ebro, Po und Arno).
W90-00273 5B

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

ESTUARINE ENVIRONMENT

Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

ETHYLENEDIAMINETETRA (METHYLENEPHOSPHONIC ACID)

Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

EUTROPHIC LAKES

Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

EUTROPHIC WATERS

Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

EUTROPHICATION

Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

EVAPORATION

Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

EVAPOTRANSPIRATION

Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

EXPERIMENTAL DESIGN

Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

FALLOUT

Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

FAR EAST

Aquatic Pollution in the Far East.
W90-00739 5B

FARM MANAGEMENT

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

FARM WASTES

Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

FATE OF POLLUTANTS

U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985.
W90-00022 5B

Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Overview of Organic Compounds in Ground Water.
W90-00054 5B

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Health and Environmental Effects Profile for Pyrene.
W90-00089 5C

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Hazardous Materials: Microbiological Decomposition, January, 1978-August, 1988: Citations from the Life Sciences Collection Database.
W90-00178 5E

Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

Health and Environmental Effects Profile for Benzo(k)Fluoranthene.
W90-00236 5C

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Health and Environmental Effects Profile for Niagara Blue 4B.
W90-00247 5C

Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

Actinide Behavior in Natural Waters.
W90-00558 5B

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

FATHEAD MINNOWS
Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

FATTY ACIDS
Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

FECAL STREPTOCOCCI
Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

FECES
Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

FEEDING RATES
Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

FEEDLOT WASTES
Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

FENS
Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

FERMENTATION
Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

FERTILIZATION
Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

FERTILIZERS
Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

FIELD TESTS
Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Field Data Acquisition Systems.
W90-00021 7B

FILAMENTOUS BACTERIA
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

FILTER MEDIA
Comparisons of Various Filtration Media.
W90-00238 5F

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

FILTRATION
Comparisons of Various Filtration Media.
W90-00238 5F

Filtration Studied with Endoscopes.
W90-00419 5F

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

FINANCING
Water and Wastewater Finance and Pricing.
W90-00176 5D

FINITE ELEMENT METHOD
Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

FINLAND
Effects of Acid Deposition on the Catchment Area of Lake Marsjoen-Basic Study (Happaman Laskeuman Vaikutuksista Marsjon-Jarven Valuma-Alufella Pruselvitys).
W90-00276 5C

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

FISH
Field Assessment of the Effects of Contaminants on Fishes.
W90-00083 5C

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

FISH BEHAVIOR
Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

FISH DIETS
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

FISH EGGS
Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

FISH FARMING
Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

FISH FOOD
Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

FISH FOOD ORGANISMS
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

FISH HATCHERIES
Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

FISH LADDERS
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

FISH MANAGEMENT
Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

FISH MIGRATION
Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

FISH PASSAGES
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

FISH PHYSIOLOGY
Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

FISH PONDS
Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

FISH POPULATIONS
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

Population Size and Status of the Razorback Sucker in the Great River Basin, Utah and Colorado.
W90-00617 8I

Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

Yellow Perch (Perca flavescens) Growth and Mortality Rates in Lake St. Clair and the Three Basins of Lake Erie, 1963-86.
W90-00849 2H

Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

FISH STOCKING
Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

FISH TOXINS
Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

FISHERIES
Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

FLAME PHOTOMETRY
Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

FLASH FLOODS
Synoptic and Meso-Alpha Scale Meteorology of Wyoming Flash Floods.
W90-00237 2B

Status Report on Flood Warning Systems in the United States.
W90-00452 6F

FLATHEAD RIVER
Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

FLOATING PLANTS
Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

FLOCCULATION
Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

FLOOD BASINS
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

FLOOD CONTROL
Spillway Performance Report, Mississippi, December 1982.
W90-00135 8B

Floodwater Retarding Structure No. 4, Misteguay Creek, Michigan: Spillway Performance Report for Flow of September 1985.
W90-00158 8A

Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

Flooding and the Quantification of 'Intangibles'.
W90-00925 6A

FLOOD DAMAGE
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

FLOOD DISCHARGE
Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

FLOOD FLOW
Response of Muskingum Equation to Step Input.
W90-00896 2E

FLOOD FORECASTING
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

FLOOD FREQUENCY
Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

FLOOD HYDROGRAPHS
Simulation of Flood Hydrographs For Georgia Streams.
W90-00221 2E

FLOOD PEAK
Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

Techniques For Estimating Streamflow Characteristics in The Eastern And Interior Coal Provinces of the United States.
W90-00203 2E

Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

FLOOD PLAINS
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

FLOOD PROFILES
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

FLOOD PROTECTION
Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

Status Report on Flood Warning Systems in the United States.
W90-00452 6F

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

FLOOD ROUTING
Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

Response of Muskingum Equation to Step Input.
W90-00896 2E

FLOOD WARNING SYSTEMS
Status Report on Flood Warning Systems in the United States.
W90-00452 6F

FLOODING
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

FLOODS
Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

FLORIDA
Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Florida Acid Deposition Research Program.
W90-00068 5C

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

FLOW
Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

FLOW AROUND OBJECTS
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

FLOW CHARACTERISTICS
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

FLOW MEASUREMENT
Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

FLOW PATTERN
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

FLOW PROFILES
Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

FLOW VELOCITY
Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

Velocity Redistribution in Meandering Rivers.
W90-00627 2E

FLOWERING
Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

FLUIDIZED BED PROCESS
Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

FLUIDIZED BEDS
Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

FLUMES
Transport and Sedimentation of Suspended Matter in Obstructed and Unobstructed Running Waters, (Transport-und Sedimentationsverhalten von Suspensa in Ungestauten und Gestauten Fliessgewaessern).
W90-00259 2J

FLUORESCENCE
Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

Flow Cytometry for Algal Studies.
W90-00903 7B

FLUORIDE
Determination of Fluoride Ions in Water by Conductometric Titration with Lanthanum Nitrates (Determinacao de Ions Fluoreto em Aguas, por Titulacao Condutometrica com Nitrato de Lantanio).
W90-00274 5A

FLUORIDES
Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

FLUORINE
Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

FLUVIAL SEDIMENTS
Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

FLY ASH
Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

FOAMING
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

FOOD CHAINS
Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

FOOD-PROCESSING WASTES
Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

FORAGES
Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

FORAMINIFERA
Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

FOREST HYDROLOGY
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

FOREST MANAGEMENT
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

FOREST SOILS
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

FOREST WATERSHEDS
Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

FORESTS
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

FORMALDEHYDE
Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

FRACTURE PERMEABILITY
Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

FRANCE
Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

FREEZING
Development and Design of Sludge Freezing Beds.
W90-00661 5E

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

FUEL
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

FUNGI
Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

FURROW IRRIGATION
Infiltration Function from Furrow Stream Advance.
W90-00894 3F

FUTURE PLANNING
Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

Directions in Water Conservation and Management in Massachusetts.
W90-00651 3D

GAGES
Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

GAGING
Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

GAMBUSIA
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

GAMMARUS
Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

GAS CHROMATOGRAPHY
Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

GASOLINE
Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

GATES
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

GENETIC ENGINEERING
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

GENETICS
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

GEOCHEMISTRY
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Role of Geochemical Processes in Hazardous-Waste Studies.
W90-00053 5B

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Quality of Ground Water in Idaho.
W90-00202 2F

Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

GEOHYDROLOGY
U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985.
W90-00022 5B

Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

GEOLOGIC FORMATIONS
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

GEOLOGIC FRACTURES
Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

GEOLOGY
Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

GEOMORPHOLOGY
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

GEOPHYSICAL EXPLORATION
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

GEOPHYSICAL SURVEYS
Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

GEOPHYSICS
Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

GEORGIA
Simulation of Flood Hydrographs For Georgia Streams.
W90-00221 2E

GEOTHERMAL STUDIES
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

GILA RIVER
Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

GLACIAL AQUIFERS
Surficial and Subsurface Distribution of Aquifer Sediments at the Bemidji, Minnesota, Research Site.
W90-00033 2F

GLACIAL DRIFT
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

GLACIAL LAKES
Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

GLACIAL SEDIMENTS
Surficial and Subsurface Distribution of Aquifer Sediments at the Bemidji, Minnesota, Research Site.
W90-00033 2F

GLACIAL SOILS
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

GLACIERS
Glaciers and Glaciology of Alaska.
W90-00077 2C

GLACIOHYDROLOGY
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

GLACIOLOGY
Glaciers and Glaciology of Alaska.
W90-00077 2C

GLEN CANYON
Glen Canyon Environmental Studies: Executive Review Committee Final Report.
W90-00095 6G

GOBY
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

GOLD
Development Document for Final Effluent Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category: Gold Placer Mine Subcategory.
W90-00096 5G

Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

GOVERNMENT SUPPORTS
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

GRADING
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

GRAND CANYON RIVER
Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

GRAVEL MINING
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

GREAT LAKES
Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

GREECE
Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

GREENHOUSE EFFECT
Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

GREENHOUSES
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

GRIT CHAMBERS
Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

GROINS
Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

GROUNDWATER
Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

Algorithm for the Interpretation of Groundwater Field Experiments.
W90-00934 2F

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

GROUNDWATER BUDGET

Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00227 2F

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

GROUNDWATER DEPLETION

Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

GROUNDWATER IRRIGATION

Rubber Heat Engine for Ground Water Irrigation in India.
W90-00291 3F

Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

GROUNDWATER LEVEL

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

GROUNDWATER MANAGEMENT

EPA: Ground Water Handbook.
W90-00087 5G

Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

GROUNDWATER MINING

Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

GROUNDWATER MOVEMENT

Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

Analytical Groundwater Modeling: Flow and Contaminant Migration.
W90-00162 2F

Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00227 2F

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

Hydraulic Calculations for Flow Under Dikes on Consolidated Beds (Untergrundhydraulische Berechnungen an Flussdeichen auf Bindigen Deckschichten).
W90-00257 2F

Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

Algorithm for the Interpretation of Groundwater Field Experiments.
W90-00934 2F

Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

GROUNDWATER MOVEMENT

Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

GROUNDWATER POLLUTION

Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985.
W90-00022 5B

Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Reexamination of the Occurrence and Distribution of Creosote Compounds in Ground Water.
W90-00025 5B

Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984.
W90-00052 5B

Overview of Organic Compounds in Ground Water.
W90-00054 5B

Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

EPA: Ground Water Handbook.
W90-00087 5G

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Ground-Water Monitoring Compliance Projects for Hanford Site Facilities.
W90-00153 5G

Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

Modelling of Large-Scale Heat and Contaminant Transport in Groundwater: Report of Activities 1986/87 (Modellerung des Grossraeumigen Waermetransports und Schadstofftransports im Grundwasser: Taetigkeitsbericht 1986/87).
W90-00269 2F

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

How to Monitor Groundwater at a Municipal Solid Waste Facility.
W90-00796 5A

Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

GROUNDWATER POTENTIAL

Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

GROUNDWATER QUALITY

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Quality of Ground Water in Idaho.
W90-00202 2F

Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

GROUNDWATER RECHARGE

Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

GROUNDWATER RESERVOIRS

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

GROWTH MEDIA

Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

GULF OF MEXICO

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

GYPSUM

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

HALOGENATED HYDROCARBONS

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

HALOGENATED PESTICIDES

Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

HALOGENS

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

HANDBOOKS

Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

EPA: Ground Water Handbook.
W90-00087 5G

Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

HARBORS

Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

HAZARDOUS MATERIALS

Hazardous Materials: Microbiological Decomposition, January, 1978-August, 1988: Citations from the Life Sciences Collection Database.
W90-00178 5E

Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

HAZARDOUS WASTE DISPOSAL

Groundwater Pollution and the Disposal of Hazardous and Radioactive Wastes.
W90-00926 5E

HAZARDOUS WASTES

U.S. Geological Survey Program on Toxic Waste--Ground-Water Contamination: Proceedings of the Second Technical Meeting, Cape Cod, Massachusetts, October 21-25, 1985.
W90-00022 5B

Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984.
W90-00052 5B

Role of Geochemical Processes in Hazardous-Waste Studies.
W90-00053 5B

Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

HAZARDS

Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

HEAD LOSS

Head Loss in Manifolds or Trickle Lateral: Simplified Approach.
W90-00897 3F

HEAT FLOW

Modelling of Large-Scale Heat and Contaminant Transport in Groundwater: Report of Activities 1986/87 (Modellerung des Grossraeumigen Waermetransports und Schadstofftransports im Grundwasser: Taetigkeitsbericht 1986/87).
W90-00269 2F

Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

HEAT TRANSFER

Heat and Moisture Losses of Heated Rivers (Waerme und Feuchteabgabe Aufgeheizter Fluesse).
W90-00182 5B

Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

HEAT TREATMENT

Effects of Thermal Pretreatment of Sewage Sludge on Anaerobic Digestion.
W90-00755 5D

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

HEAVY METALS
Mine-Water Discharge, Metal Loading, and Chemical Reactions.
W90-00039 5B

Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Heavy Metals in Drinking Water: Standards, Sources, and Effects, January, 1978-September, 1988: Citations from the Life Sciences Collection Database.
W90-00179 5F

Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectroscopic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tiefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissionsspektrometrischer Ver-fahren).
W90-00186 5A

Seasonal Variation in Uptake and Retention of Cadmium in the Seaweed Zostera marina L. from the Kiel Fjord (Western Baltic Sea) (Jahresgang, Aufnahme und Verbleib von Cadmium im Seegras Zostera Marina L. aus der Kieler Forde (Westliche Ostsee)).
W90-00260 5B

Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

Heavy Metal Concentrations in the Mediterranean Estuarine Regions of the Rhone, Ebro, Po, and Arno Rivers (Ermittlung der Aktuellen Schwermetallbelastungen in den Mittelmeerasestuarien von Rhone, Ebro, Po und Arno).
W90-00273 5B

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

HERBICIDES

Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

HETEROTROPHIC BACTERIA

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

HETEROTROPHIC MICROORGANISMS

Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

HIGH FLOW

Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

HIGH WATER MARK

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

HIGHWAY EFFECTS

Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

HIGHWAY RUNOFF

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

HIGHWAYS

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

HISTORY

Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

HOHOKAM INDIANS

Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6G

HONG KONG

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

HOT WIRE HYGROMETERS

Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

HUMAN PATHOLOGY

Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

HUMIC ACIDS

Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

HUNTING

Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

HYDRAULIC CONDUCTIVITY

Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

Wettable Porous Plastic for Use as a Porous Barrier in Soil Hydraulic Studies.
W90-00389 2G

Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

HYDRAULIC DESIGN

Hydrologic Design for Riprap on Embankment Slopes.
W90-00084 8D

HYDRAULIC ENGINEERING

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Cohesive Sediment Transport: II. Application.
W90-00631 2L

Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

HYDRAULIC EQUIPMENT

Spinning Air Blasts Operating Costs.
W90-00668 5D

HYDRAULIC GRADIENT

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

HYDRAULIC MODELS

Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

HYDRAULIC PROPERTIES

Spillway Performance Report, Mississippi, December 1982.
W90-00135 8B

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

HYDRAULIC STRUCTURES
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

Cutoff Wall Construction to Upgrade Mud Mountain Dam.
W90-00155 8E

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

HYDRAULIC VALVES
Spinning Air Blasts Operating Costs.
W90-00668 5D

Pump-Control Valves Protect Your Water System.
W90-00669 5F

HYDROCARBONS
Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

HYDRODYNAMICS
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

HYDROGEN
Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

HYDROGEN ION CONCENTRATION
Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

HYDROGEN SULFIDE
Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

HYDROGRAPHS
Simulation of Flood Hydrographs For Georgia Streams.
W90-00221 2E

HYDROGRAPHY
Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

HYDROLOGIC BUDGET
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Modelling the Irrigaiton Need.
W90-00957 3F

HYDROLOGIC CYCLE
Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

HYDROLOGIC DATA
Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Minimum Data Sets: Hydrological Applications.
W90-00103 3F

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Hydrologic Unit Maps.
W90-00207 7C

HYDROLOGIC DATA COLLECTIONS
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

Techniques For Estimating Streamflow Characteristics in The Eastern And Interior Coal Provinces of the United States.
W90-00203 2E

HYDROLOGIC MODELS
Review of Hydrologic and Water Quality Models Used for Simulation of Agricultural Pollution.
W90-00002 5B

Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Validity and Limitations of Different Transport Models with Particular Reference to Sediment Transport.
W90-00011 2J

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

Cohesive Sediment Transport: II. Application.
W90-00631 2L

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

HYDROLOGIC PROPERTIES
Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

HYDROLOGIC SYSTEMS
Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

HYDROLOGIC UNIT MAPS
Hydrologic Unit Maps.
W90-00207 7C

HYDROLOGICAL REGIME
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

HYDROLOGY
Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

HYDROLYSIS
Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

HYDROMETEOROLOGY
Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

HYGROMETERY
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

ICE COVER
Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

IDAHO
Quality of Ground Water in Idaho.
W90-00202 2F

Geology and Survival on the Snake River Plain.
W90-00335 5G

ILLINOIS
Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

IMPAIRED WATER USE
Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

IMPERVIOUS SOILS
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

INDIA
Rubber Heat Engine for Ground Water Irrigation in India.
W90-00291 3F

Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

INDIAN OCEAN
Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

INDIANA
Indiana Water Quality 1987: Monitor Station Records, Rivers and Stream.
W90-00079 5B

Indiana Water Quality 1986. Monitor Station Records--Rivers and Streams.
W90-00127 2E

Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

INDONESIA
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

INDUCTION METERS
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

INDUSTRIAL DEVELOPMENT
Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

INDUSTRIAL PLANTS
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

INDUSTRIAL WASTES
Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

Wastewater Management in the Automobile Industry.
W90-00769 5D

Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

INDUSTRIAL WASTEWATER
Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

INDUSTRIAL WASTEWATER

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Removal of Copper From Solution Using Moss.
W90-00496 5D

Aquatic Pollution in the Far East.
W90-00739 5B

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

INFILTRATION

Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

Algorithm for the Interpretation of Groundwater Field Experiments.
W90-00934 2F

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

INFILTRATION RATE

Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

Infiltration Function from Furrow Stream Advance.
W90-00894 3F

INFORMATION SYSTEMS

REMISS: Research Management Information System.
W90-00129 10D

INJECTION WELLS

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

INORGANIC ACIDS

Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

INORGANIC COMPOUNDS

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

INSECTICIDES

Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

INSTREAM FLOW

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

INSTRUMENTATION

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

Flow Cytometry for Algal Studies.
W90-00903 7B

INTAKES

Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

INTERCEPTION

Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

INTERDISCIPLINARY STUDIES

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

INTERNATIONAL AGREEMENTS

Monitoring of the Sea: Report on the Activities in 1984 (Ueberwachung des Meeres: Bericht fuer das Jahr 1984).
W90-00263 5A

Monitoring of the Sea: Report on the Activities in 1983 (Ueberwachung des Meeres: Bericht fuer das Jahr 1983).
W90-00264 5A

INTERNATIONAL WATERS

Monitoring of the Sea: Report on the Activities in 1984 (Ueberwachung des Meeres: Bericht fuer das Jahr 1984).
W90-00263 5A

Monitoring of the Sea: Report on the Activities in 1983 (Ueberwachung des Meeres: Bericht fuer das Jahr 1983).
W90-00264 5A

INTERSTITIAL WATER

Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

INTERTIDAL AREAS

Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

INTRODUCED SPECIES

Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

INVERTEBRATES

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

IODINE

Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

ION EXCHANGE

Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

IONS

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

IOWA

Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

IRAQ

Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

Evaluation of Septic Tanks Performance in Some Parts of Mosul City in Iraq.
W90-00546 5D

Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

IRON

Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

IRRADIATION

Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

IRRIGATION

Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

IRRIGATION CANALS

Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

Central Asian Irrigation Canals and some Aspects of their Algal Flora.
W90-00408 2H

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

IRRIGATION EFFECTS

Wellton-Mohawk Farmers Deliver Water Conservation.
W90-00325 3F

Geology and Survival on the Snake River Plain.
W90-00335 5G

Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

IRRIGATION EFFICIENCY

Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

IRRIGATION ENGINEERING

Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

Infiltration Function from Furrow Stream Advance.
W90-00894 3F

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

Head Loss in Manifolds or Trickle Lateral: Simplified Approach.
W90-00897 3F

Modelling the Irrigaiton Need.
W90-00957 3F

IRRIGATION OPERATION

Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

IRRIGATION PRACTICES

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

IRRIGATION PROGRAMS

Wellton-Mohawk Farmers Deliver Water Conservation.
W90-00325 3F

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

IRRIGATION REQUIREMENTS

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

Research Needs in Irrigation and Drainage--1989.
W90-00893 3F

Modelling the Irrigaiton Need.
W90-00957 3F

IRRIGATION WATER
Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

ISOLEUCINE
Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

ISOTOPE STUDIES
Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

ITALY
Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

Heavy Metal Concentrations in the Mediterranean Estuarine Regions of the Rhone, Ebro, Po, and Arno Rivers (Ermittlung der Aktuellen Schwermetallbelastungen in den Mittelmeeraestuarien von Rhone, Ebro, Po und Arno).
W90-00273 5B

Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

IVERMECTIN
Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

JAPAN
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

JETTIES
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

JOHNSTONE RIVER ESTUARY
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

JORDAN
State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

KANSAS
Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

KAOLINITE
Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

KARST
Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

KARST HYDROLOGY
Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

KENTUCKY
Acid Deposition Research and Policy.
W90-00069 5B

Kentucky, May 1984: Spillway Performance Report.
W90-00157 8A

KESTERSON RESERVOIR
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

KINETICS
Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

KRAFT MILLS
Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

LABORATORY EQUIPMENT
Flow Cytometry for Algal Studies.
W90-00903 7B

LABORATORY METHODS
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

LACUSTRINE ENVIRONMENT
Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

LAGOONS
Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

LAKE BAIKAL
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

LAKE BASINS
Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

LAKE BIWA
Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

LAKE ELLYN
Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

LAKE ERIE
Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

Yellow Perch (Perca flavescens) Growth and Mortality Rates in Lake St. Clair and the Three Basins of Lake Erie, 1963-86.
W90-00849 2H

Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

LAKE FISHERIES

Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

LAKE ICE

Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

LAKE MANAGEMENT

Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

LAKE MICHIGAN

Observations of Concurrent Drifting Buoy and Current Meter Measurements in Lake Michigan.
W90-00839 2H

LAKE MORPHOLOGY

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

LAKE ONTARIO

Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

LAKE POWELL

1986 Lake Powell Survey.
W90-00126 2J

LAKE REGULATION

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

LAKE RESTORATION

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Bilogisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

LAKE SEDIMENTS

Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

LAKE SIMCOE

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

LAKE STAGES

Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

LAKE SUPERIOR

Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

LAKES

Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Bilogisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

LAKES

Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Microorganisms and the Aquatic Environment.
W90-00724 2H

Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

LAND DEVELOPMENT

Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

LAND DISPOSAL

Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

Improvements in Soil Absorption Trench Design.
W90-00665 5D

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

LAND MANAGEMENT

Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

LAND TREATMENT

Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

LAND USE

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

LANDFILLS

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

LAPLACE EQUATION

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

LARVAE

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

LARVAL GROWTH STAGE

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

LEACHATES

Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Cadmium Soil Sorption at Low Concentrations: VII, Effect of Stable Solid Waste Leachate Complexes.
W90-00802 5B

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

LEACHING

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

LEAD

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

LEAKAGE

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

LEAVES

Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

LEECHES

Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

LEGAL ASPECTS

Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

LEGISLATION

Save the Rain.
W90-00066 5G

Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

Wisconsin Acid Deposition Program.
W90-00073 5G

Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

LEGUMES

Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

LETHAL LIMIT

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

LEVEES

Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

LIFE CYCLES

Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

LIGNIN

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

LIME

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Investigations on Treatment of Wastewater and Sludge, Nitrification and Reduction of Phosphates in Lime Pre-precipitation with Subsequent Aerobic Stabilization (Untersuchungen zur Abwasser-und Schlamm-hygienisierung, Nitrifikation und Phosphatverminderung bei der Kalkvorfallung mit Nachfolgender aerober Stabilisierung).
W90-00258 5D

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Biologisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

LIMITING NUTRIENTS

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Microorganisms and the Aquatic Environment.
W90-00724 2H

LIMNOLOGY

Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

Microorganisms and the Aquatic Environment.
W90-00724 2H

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

LIMNOLOYG

Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

LINDANE

Lindane.
W90-00171 5G

LINEAR ALKYL SULFONATES

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

LINEAR PROGRAMMING

Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

LINERS

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

LININGS

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

LIPIDS

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

LIQUEFACTION

Cone Penetration Testing for Evaluating the Liquefaction Potential of Sands.
W90-00125 8D

LITERATURE REVIEW

Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

LITTER

Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

LITTLE COLORADO RIVER

Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

LITTORAL ZONE

Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

LOAD TESTING

Dynamic Load Testing of Piles (Kynamische Tragfaehigkeitspruefungen bei Bohrpfaehlen).
W90-00262 8G

LOCKS

Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

LOGGING

Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

LONG ISLAND

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

LOTIC ENVIRONMENT

Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

LOUISIANA

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

LOVE CANAL

Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

LOW FLOW
Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

LUBRICANTS
Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

LUKE AIR FORCE BASE
Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

LYSIMETERS
Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

MACROINVERTEBRATES
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

MACROPHYTES
Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

MADISON-BIGHORN AQUIFER
Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

MAGNESIUM
Magnesium.
W90-00167 5G

Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

MAGOTHY AQUIFER
Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

MAINE
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

MAINTENANCE
Get Control of Your Activated Sludge Process.
W90-00667 5D

MALATHION
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

MALAYSIA
Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

MAMMALS
Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

MANAGEMENT INFORMATION SYSTEMS
REMISS: Research Management Information System.
W90-00129 10D

MANAGEMENT PLANNING
Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

Acid Deposition Program: Scope of Work.
W90-00072 5B

Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

REMISS: Research Management Information System.
W90-00129 10D

Acid Rain: Delays and Management Changes in the Federal Research Program.
W90-00138 5B

Blueprint for the Environment: A Plan for Federal Action.
W90-00161 5G

Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

MANGANESE
Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

MANITOBA
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

MAPPING
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

MAPS
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

Hydrologic Unit Maps.
W90-00207 7C

MARINE BACTERIA
Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

MARINE ENVIRONMENT
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

Microorganisms and the Aquatic Environment.
W90-00724 2H

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

MARINE ENVIRONMENTS
Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

MARINE SEDIMENTS
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

MARSH PLANTS
Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

MARSHES
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

MARYLAND
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

MASS SPECTROMETRY
Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

MASS TRANSFER
Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

MASSACHUSETTS
Directions in Water Conservation and Management in Massachusetts.
W90-00651 3D

Overview of the MWRA Water Conservation Program.
W90-00652 3D

MATERIALS ENGINEERING
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

MATERIALS TESTING
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

MATHEMATICAL ANALYSIS
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

MATHEMATICAL MODELS
Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Development and Application of a Model for Regional Water Quality Management.
W90-00835 5G

Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

MATHEMATICAL STUDIES
Estimating Climatic Data.
W90-00105 7C

Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

MAXIMUM ENTROPY METHOD
Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

MEANDERS
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

MEASURING INSTRUMENTS
Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

MEDITERRANEAN
Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

MEDITERRANEAN SEA
Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

MELON
Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

MELON SEED HUSKS
Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

MEMBRANE FILTERS
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

MEMBRANE PROCESSES
Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

MERCURY
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

METABOLISM
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

METAL COMPLEXES
Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

METAL-FINISHING WASTES
Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

METALS
Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

METEOROLOGIC DATA COLLECTION
Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Bureau's Data Bank--How It Works.
W90-00119 7C

METEOROLOGICAL DATA COLLECTION
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

METEOROLOGY
Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

Synoptic and Meso-Alpha Scale Meteorology of Wyoming Flash Floods.
W90-00237 2B

METEROLOGICAL DATA COLLECTION
Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

METHANE
Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

METHANE BACTERIA
Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

METHANOL
Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

METHYLMERCURY
Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

MEUSE RIVER
Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

MEXICO
Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

MICE
Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

MICHIGAN
Floodwater Retarding Structure No. 4, Misteguay Creek, Michigan: Spillway Performance Report for Flow of September 1985.
W90-00158 8A

Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

MICROBIAL DEGRADATION
Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

MICROBIOLOGICAL STUDIES
Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

MICROCOMPUTERS
Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

MICROORGANISMS
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Microorganisms and the Aquatic Environment.
W90-00724 2H

MICROSCOPY

Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

MIDGES

Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

MILITARY INSTALLATION

Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

MILITARY INSTALLATIONS

Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

MILITARY RESERVATIONS

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

MILK

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

MINE DRAINAGE

Mine-Water Discharge, Metal Loading, and Chemical Reactions.
W90-00039 5B

Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Development Document for Final Effluent Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category: Gold Placer Mine Subcategory.
W90-00096 5G

MINE WASTES

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Development Document for Final Effluent Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category: Gold Placer Mine Subcategory.
W90-00096 5G

Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

MINERAL WATER

Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

MINERALIZATION

Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

MINERALOGY

Clay Mineralogy of Sediments Associated with a Plume of Creosote-Contaminated Ground Water.
W90-00023 2K

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

MINERALS

Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

MINING EFFECTS

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

MINNESOTA

Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

MINNOW

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

MISSISSIPPI

Black Creek No. 53, Mississippi, May 1983: Spillway Performance Report.
W90-00156 8A

MISSISSIPPI RIVER

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

MIXING

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

MODEL STUDIES

Agricultural Nonpoint Source Pollution: Model Selection and Application.
W90-00001 5B

Developments in Ecological Modelling.
W90-00003 7C

Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Validity and Limitations of Different Transport Models with Particular Reference to Sediment Transport.
W90-00011 2J

Selection and Application of Models for Non-point Source Pollution and Resource Conservation.
W90-00012 5B

Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simula-

tion and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

Modeling Sorptive Processes in Laboratory Columns.
W90-00058 2K

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Statistical Rain Attenuation Prediction Model with Application to the Advanced Communication Technology Satellite Project. I--Theoretical Development and Application to Yearly Predictions for Selected Cities in the United States.
W90-00094 2B

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00227 2F

Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

Review of Acid Rain Models for Europe.
W90-00233 5B

Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

Modelling of Large-Scale Heat and Contaminant Transport in Groundwater: Report of Activities 1986/87 (Modellerung des Grossraeumigen Waermetransports und Schadstofftransports im Grundwasser: Taetigkeitsbericht 1986/87).
W90-00269 2F

Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

Simple Empirical Model of Root Water Uptake.
W90-00355 2I

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

Velocity Redistribution in Meandering Rivers.
W90-00627 2E

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

River Quality Modeling: Time Domain Approach.
W90-00889 5B

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

Modelling the Irrigaiton Need.
W90-00957 3F

MOISTURE STRESS

Detection of Moisture Stress by Indicator Plots--A Simulation.
W90-00574 2I

MOISTURE UPTAKE

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

MOLECULAR STRUCTURE

Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

MOLLUSKS

Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

MOLYBDENUM

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

MONITORING

Field Assessment of the Effects of Contaminants on Fishes.
W90-00083 5C

Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

Monitoring of the Sea: Report on the Activities in 1984 (Ueberwachung des Meeres: Bericht fuer das Jahr 1984).
W90-00263 5A

Monitoring of the Sea: Report on the Activities in 1983 (Ueberwachung des Meeres: Bericht fuer das Jahr 1983).
W90-00264 5A

Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

Analytical Chemistry for Environmental Sciences.
W90-00542 5A

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

How to Monitor Groundwater at a Municipal Solid Waste Facility.
W90-00796 5A

Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

MONITORING WELLS

Ground-Water Monitoring Compliance Projects for Hanford Site Facilities.
W90-00153 5G

MONTANA

Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

MONTE CARLO METHOD

Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

MONTMORILLONITE

Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

MOROCCO

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

MOSSES

Removal of Copper From Solution Using Moss.
W90-00496 5D

MOUND SEWAGE SYSTEMS

Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

MOUNTAINS

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

MUD

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

MUD-WATER INTERFACES

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

MULCHING

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

MULTIPURPOSE RESERVOIRS

Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

MUNICIPAL WASTEWATER

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

MUSKINGUM EQUATION
Response of Muskingum Equation to Step Input.
W90-00896 2E

MUSSELS
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

MUTAGENICITY
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

MYCOBACTERIUM
Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

NANTUCKET
Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

NATURAL RESOURCES
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

NATURAL WATERS
Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

NAVIGATION
Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

NAVIGATION CANALS
Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

NEODYMIUM
Actinide Behavior in Natural Waters.
W90-00558 5B

NETWORK DESIGN
Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

NETWORKS
Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

NEUTRALIZATION
Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

NEUTRON ACTIVATION ANALYSIS
Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

NEVADA
Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

NEW JERSEY
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

NEW MEXICO
Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

NEW YORK
Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

NEW ZEALAND
Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

Influence of the 1982-83 Drought on River Flows in Hawke's Bay.
W90-00932 2E

Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

NIAGARA BLUE
Health and Environmental Effects Profile for Niagara Blue 4B.
W90-00247 5C

NIAGARA FALLS
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

NIAGARA RIVER
Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

NICKEL
Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

NITRATES
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

NITRATES

Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

NITRIFICATION

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

NITRITES

Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

NITROGEN

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

NITROGEN CYCLE

Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

NITROGEN FIXATION

Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

NITROGEN OXIDES

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

NITROGEN REMOVAL

Nitrogen Removal Works Year-Round.
W90-00552 5D

Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

NITROPHENOL

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

NITROPHENOLS

Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

NO-TILL CULTIVATION

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

NONIONIC SURFACTANTS

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

NONPOINT POLLUTION SOURCES

Agricultural Nonpoint Source Pollution: Model Selection and Application.
W90-00001 5B

Review of Hydrologic and Water Quality Models Used for Simulation of Agricultural Pollution.
W90-00002 5B

Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

Field Data Acquisition Systems.
W90-00021 7B

Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

NONUNIFORM FLOW

Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

NORTH DAKOTA

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

NORTH SEA

Monitoring of the Sea: Report on the Activities in 1984 (Ueberwachung des Meeres: Bericht fuer das Jahr 1984).
W90-00263 5A

Monitoring of the Sea: Report on the Activities in 1983 (Ueberwachung des Meeres: Bericht fuer das Jahr 1983).
W90-00264 5A

NUCLEAR ACCIDENTS
Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

NUISANCE ALGAE
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

NUMERICAL ANALYSIS
Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

NUTRIENT REMOVAL
Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

NUTRIENTS
Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Streamflow, Sediment Transport, and Nutrient Transport at Incline Village, Lake Tahoe, Nevada, 1970-73.
W90-00219 2E

Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Microorganisms and the Aquatic Environment.
W90-00724 2H

Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

OBSERVATION WELLS
Ground-Water Monitoring Compliance Projects for Hanford Site Facilities.
W90-00153 5G

OCEAN DUMPING
Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

OCTACHLOROSTYRENE
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

OHIO
Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

OIL
Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

OIL POLLUTION
Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta

OIL POLLUTION

Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

OIL RECOVERY

Oil Spill Recovery: Oil Booms and Skimmers, January, 1971-October, 1988: Citations from the U.S. Patent Bibliographic Database.
W90-00183 5G

OIL SHALE

Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

OIL SPILLS

Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

Oil Spill Recovery: Oil Booms and Skimmers, January, 1971-October, 1988: Citations from the U.S. Patent Bibliographic Database.
W90-00183 5G

In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

OIL WASTES

Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

OIL-WATER INTERFACES

Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

OLIGOTROPHIC LAKES

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

OLIGOTROPHY

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

ON-SITE WASTE DISPOSAL

Onsite Wastewater Disposal.
W90-00175 5D

ON-SITE WASTEWATER TREATMENT

Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

ONTARIO

What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

OPEN-CHANNEL FLOW

Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

Air-Water Gas Transfer in Open Channels.
W90-00944 2E

OPERATING COSTS

Spinning Air Blasts Operating Costs.
W90-00668 5D

Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

OPTIMIZATION

Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

OPTIMUM DEVELOPMENT PLANS

Percival Creek Corridor Plan.
W90-00326 6B

ORGANIC ACIDS

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

ORGANIC CARBON

Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

ORGANIC COMPOUNDS

Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Overview of Organic Compounds in Ground Water.
W90-00054 5B

Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

ORGANIC MATTER

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

ORGANIC WASTES

Development and Investigation of a Process for the Electrochemical Treatment of Wastewater (Entwicklung und Untersuchung eines Verfahrens zur Elektrochemischen Aufbereitung von Abwasser).
W90-00268 5D

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

ORGANOLEAD COMPOUNDS

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

ORGANOLEPTIC PROPERTIES

Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

ORGANOPHOSPHORUS PESTICIDES

Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

ORGANOTIN COMPOUNDS

Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

ORGANOTINS

Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

ORINOCO RIVER

Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

OSMOREGULATION

Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

OTTERS

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

OVERFLOW

Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

OVERLAND FLOW

Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

OXIDATION PROCESS

Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

OXIDATION-REDUCTION POTENTIAL

Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

OXYGEN

Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

OXYGEN TRANSFER

Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

OYSTERS

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

OZONATION

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

OZONE

Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

PACKED BEDS

Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

PALEOLIMNOLOGY

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

PARAMETRIC HYDROLOGY

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

PARTIAL DURATION SERIES MODEL

Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

PARTICLE SIZE

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

PARTÍCULATE MATTER

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

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W90-00183 5G

PATH OF POLLUTANTS
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W90-00001 5B

Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Selection and Application of Models for Non-point Source Pollution and Resource Conservation.
W90-00012 5B

Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

Development, Testing, and Applications of Non-point Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

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W90-00022 5B

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W90-00023 2K

Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Reexamination of the Occurrence and Distribution of Creosote Compounds in Ground Water.
W90-00025 5B

Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

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W90-00052 5B

Role of Geochemical Processes in Hazardous-Waste Studies.
W90-00053 5B

Overview of Organic Compounds in Ground Water.
W90-00054 5B

Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Modeling Sorptive Processes in Laboratory Columns.
W90-00058 2K

Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Analytical Groundwater Modeling: Flow and Contaminant Migration.
W90-00162 2F

Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

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W90-00197 5B

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

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W90-00226 5B

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W90-00229 5B

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W90-00261 5B

Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

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W90-00269 2F

Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

PCBs and DDT in Saginaw Bay White Suckers.
W90-00485 5B

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

Actinide Behavior in Natural Waters.
W90-00558 5B

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

Aquatic Pollution in the Far East.
W90-00739 5B

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Cadmium Soil Sorption at Low Concentrations: VII, Effect of Stable Solid Waste Leachate Complexes.
W90-00802 5B

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

PATHOGENIC BACTERIA

Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

PATUXENT RIVER

Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

PEANUTS

Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

PEARL RIVER

Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

PEAT

Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

PEAT SOILS

Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

PENNSYLVANIA

Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

PENTACHLOROPHENOL

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

PERCH

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Yellow Perch (Perca flavescens) Growth and Mortality Rates in Lake St. Clair and the Three Basins of Lake Erie, 1963-86.
W90-00849 2H

PERCOLATION

Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

PERMEAMETERS

Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

PERMETHRIN

Aqueous Chlorination of Permethrin.
W90-00914 5F

PERMETHRINS

Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

PERMETHYLSILOXANES

Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

PESTICIDE RESIDUES

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

PESTICIDE TOXICITY

Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to

Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

PESTICIDES

Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

Water Solubility Enhancements of DDT and Trichlorobenzene by Some Surfactants Below and Above the Critical Micelle Concentration.
W90-00536 5B

Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

PETROLEUM PRODUCTS

Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

PHENANTHRENE

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

PHENOLS

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

PHILIPPINES

Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

PHOSPHATES

Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

PHOSPHOROUS

Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

PHOSPHORUS

Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

PHOSPHORUS REMOVAL

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

Role of Acetate in Denitrification and Biological Phosphate Removal in Modified Bardenpho Systems.
W90-00780 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

PHOTOLYSIS
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

PHOTOMETRY
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

PHOTORESPIRATION
Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

PHOTOSYNTHESIS
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthesis of Salt Marsh Species.
W90-00605 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

PHTHALATES
Health and Environmental Effects Profile for Phthalic Acid Esters (PAEs).
W90-00253 5C

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

PHYSIOLOGICAL ECOLOGY
Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

PHYTOPLANKTON
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

Flow Cytometry for Algal Studies.
W90-00903 7B

PIEZOMETERS
Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

PILES
Dynamic Load Testing of Piles (Kynamische Tragfaehigkeitspruefungen bei Bohrpfaehlen).
W90-00262 8G

PINE TREES
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

PIPELINES
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

Engineering Approach to Waterline Thrust Restraint.
W90-00795 8A

PLANKTON
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

PLANT GROWTH
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

PLANT MORPHOLOGY
Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

PLANT PHYSIOLOGY
Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

Photosynthesis of Salt Marsh Species.
W90-00605 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

PLANT POPULATIONS
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

PLANT TISSUES
Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

PLASTICS
Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

PLUMES
Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

PLUTONIUM
Actinide Behavior in Natural Waters.
W90-00558 5B

PO RIVER
Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

POLAND
Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

POLAROGRAPHIC ANALYSIS
Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

POLICY MAKING
Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

Acid Deposition Research and Policy.
W90-00069 5B

POLITICAL ASPECTS
Blueprint for the Environment: A Plan for Federal Action.
W90-00161 5G

Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

POLLUTANT IDENTIFICATION
Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectroscopic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tlefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissionsspektrometrischer Ver-fahren).
W90-00186 5A

Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Chromatography for Water Pollution Analysis, January, 1977-October, 1988: Citations from the Energy Data Base.
W90-00256 5A

Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

Analytical Chemistry for Environmental Sciences.
W90-00542 5A

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

POLLUTANTS

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

POLLUTION INDEX

Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

POLLUTION LOAD

Mine-Water Discharge, Metal Loading, and Chemical Reactions.
W90-00039 5B

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

POLLUTION VULNERABILITY

Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

POLYCHAETES

Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

POLYCHLORINATED BIPHENYLS

Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs): 1987 Review of the Draft Final.
W90-00085 5G

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

PCBs and DDT in Saginaw Bay White Suckers.
W90-00485 5B

Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

POLYCYCLIC AROMATIC HYDROCARBONS

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

POLYMERS

Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

POPULATION DENSITY

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity

Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

POPULATION DYNAMICS
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

Population Size and Status of the Razorback Sucker in the Great River Basin, Utah and Colorado.
W90-00617 8I

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

POPULATION EXPOSURE
Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

POROUS MEDIA
Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

POTABLE WATER
Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

POTOMAC RIVER
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

POWER PLANTS
Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

POWERPLANTS
From Experimental to Large Tidal Power Stations (20th Anniversary of the Kislogubsk Tidal Power Station).
W90-00787 8C

Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

PRECIPITATION
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

PRETREATMENT OF WASTEWATER
Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

PRETREATMENT OF WATER
Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

PRICING
Water and Wastewater Finance and Pricing.
W90-00176 5D

PRIMARY PRODUCTIVITY
Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

PRIORITY POLLUTANTS
Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

PROBABILISTIC PROCESS
Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

PROBABILITY DISTRIBUTION
Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

PROCESS CONTROL
Get Control of Your Activated Sludge Process.
W90-00667 5D

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

PRODUCTIVITY
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

PROTEINS
Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

PSEUDOMONAS
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

PUBLIC HEALTH
Review of the Selenium Health Criteria Document.
W90-00090 5G

Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources.
W90-00163 5G

Health Effects of Drinking Water Treatment Technologies.
W90-00177 5F

Heavy Metals in Drinking Water: Standards, Sources, and Effects, January, 1978-September,

1988: Citations from the Life Sciences Collection Database.
W90-00179 5F

Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

PUERTO RICO
Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

PUGET SOUND
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

PULP AND PAPER INDUSTRY
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

PULP WASTES
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

PUMPING
Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

PUMPING TESTING
Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

PUMPING TESTS
Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

PUMPS
Rubber Heat Engine for Ground Water Irrigation in India.
W90-00291 3F

Pump-Control Valves Protect Your Water System.
W90-00669 5F

PURPLE LOOSESTRIFE
Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

PYRENE
Health and Environmental Effects Profile for Pyrene.
W90-00089 5C

QUALITY CONTROL
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

QUANTITATIVE ANALYSIS
Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

Flow Cytometry for Algal Studies.
W90-00903 7B

QUEBEC
Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

RADIOACTIVE DATING
Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectroscopic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tiefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissionsspektrometrischer Ver-fahren).
W90-00186 5A

RADIOACTIVE TRACERS
Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

RADIOACTIVE WASTE DISPOSAL
Groundwater Pollution and the Disposal of Hazardous and Radioactive Wastes.
W90-00926 5E

RADIOACTIVE WASTES
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Ground-Water Monitoring Compliance Projects for Hanford Site Facilities.
W90-00153 5G

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

Actinide Behavior in Natural Waters.
W90-00558 5B

RADIOCHEMICAL ANALYSIS
Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectroscopic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tiefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissionsspektrometrischer Ver-fahren).
W90-00186 5A

RADIOISOTOPES
Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

RADIOMETRY
Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

RADON
Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

RADON RADIOISOTOPES
SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

RAIN
Statistical Rain Attenuation Prediction Model with Application to the Advanced Communication Technology Satellite Project. I--Theoretical Development and Application to Yearly Predictions for Selected Cities in the United States.
W90-00094 2B

Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

RAIN FORESTS
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

RAINFALL
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

RAINFALL DISTRIBUTION
Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

RAINFALL IMPACT
Assessment of Rainfall Erosion Hazard.
W90-00113 2J

RAINFALL INFILTRATION
Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

RAINFALL INTENSITY
Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

RAINFALL-RUNOFF RELATIONSHIPS
Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

Synoptic and Meso-Alpha Scale Meteorology of Wyoming Flash Floods.
W90-00237 2B

Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

RAINSTORMS
Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

RECHARGE
Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

RECHARGE BASINS
Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

RECREATION
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

Water Recreation and Risk.
W90-00923 4C

RECYCLING
Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

RED RIVER
Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

REEDS
Sewage Treatment by Reed Bed Systems.
W90-00929 5D

REGIONAL ANALYSIS
Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

REGIONAL FLOODS
Status Report on Flood Warning Systems in the United States.
W90-00452 6F

REGIONAL PLANNING
Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

Development and Application of a Model for Regional Water Quality Management.
W90-00835 5G

REGULATIONS
Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs): 1987 Review of the Draft Final.
W90-00085 5G

Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

REHABILITATION
Economic Impact of Micro Catchment Development.
W90-00882 4A

REMEDIAL ACTION
Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

REMOTE SENSING
Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

RESEARCH PRIORITIES
Florida Acid Deposition Research Program.
W90-00068 5C

Acid Deposition Research and Policy.
W90-00069 5B

Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Acid Rain: Delays and Management Changes in the Federal Research Program.
W90-00138 5B

Research Recommendations.
W90-00173 5G

Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

Research Needs in Irrigation and Drainage--1989.
W90-00893 3F

RESERVOIR CAPACITY
Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

RESERVOIR CONSTRUCTION
Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

RESERVOIR FISHERIES
Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

RESERVOIR LININGS
Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

RESERVOIR OPERATION
Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

Economic Impact of Micro Catchment Development.
W90-00882 4A

Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

Operation of Water Supply Reservoirs by 'Control Bands' Derived by Simulation.
W90-00941 4A

RESERVOIR SILTING
1986 Lake Powell Survey.
W90-00126 2J

RESERVOIR STORAGE
Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

RESERVOIRS
Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

RESIDUAL CHLORINE
Aqueous Chlorination of Permethrin.
W90-00914 5F

RESOURCE ALLOCATION
Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

RESOURCES CONSERVATION AND RECOVERY ACT
Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

RESOURCES DEVELOPMENT
Impacts of a Proposed Coal Mine in the Flathead River Basin.
W90-00128 4C

Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6C

RESOURCES MANAGEMENT
Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

RESPIRATION
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

REVIEWS
Review of the Selenium Health Criteria Document.
W90-00090 5G

RHINE RIVER
Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

RHIZOSPHERE
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

RICE
Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

RIPRAP
Hydrologic Design for Riprap on Embankment Slopes.
W90-00084 8D

RISK ASSESSMENT
Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Drinking Water Standards and Risk Assessment.
W90-00922 5G

Water Recreation and Risk.
W90-00923 4C

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

RIVER BASINS
Hydrologic Unit Maps.
W90-00207 7C

RIVER ELBE
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

RIVER FLOW
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

RIVER FORECASTING
River Quality Modeling: Time Domain Approach.
W90-00889 5B

Response of Muskingum Equation to Step Input.
W90-00896 2E

RIVER MECHANICS
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

RIVER MOUTH
Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

RIVER MOUTHS
Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

RIVER SEDIMENTS
Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

RIVERS
Indiana Water Quality 1986: Monitor Station Records--Rivers and Streams.
W90-00127 2E

Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

RODENTS
Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

ROOF CATCHMENT
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

ROOT DEVELOPMENT
Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

ROOT ZONE
Simple Empirical Model of Root Water Uptake.
W90-00355 2I

Solute Movement Through Root-soil Environment.
W90-00885 2I

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

ROOTS
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

ROUTING
Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

Response of Muskingum Equation to Step Input.
W90-00896 2E

RUBIDIUM RADIOISOTOPES
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

RUN-OFF
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

RUNOFF
Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

RUNOFF FORECASTING
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

RURAL AREAS
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

SALINE-FRESHWATER INTERFACES
Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

SALINE LAKES
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

SALINE SOILS
Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

SALINE WATER
Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

SALINE WATER INTRUSION
Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

Diversion Project Alleviates Saltwater Intrusion.
W90-00798 5G

SALINITY
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

SALINITY CURRENTS
Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

SALMON
Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

SALMON

Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

SALMONELLA

Investigations on Treatment of Wastewater and Sludge, Nitrification and Reduction of Phosphates in Lime Pre-precipitation with Subsequent Aerobic Stabilization (Untersuchungen zur Abwasser-und Schlamm-hygienisierung, Nitrifikation und Phosphatverminderung bei der Kalkvorfallung mit Nachfolgender aerober Stabilisierung).
W90-00258 5D

SALT BALANCE

Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

SALT MARSHES

Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

Photosynthesis of Salt Marsh Species.
W90-00605 2H

Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

SALT REJECTION

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

SALT TOLERANCE

Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

SALTS

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

SAMPLE PREPARATION

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

SAMPLE PRESERVATION

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

SAMPLERS

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

SAMPLING

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

SAN FRANCISCO BAY

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

SAN JOAQUIN VALLEY

Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

SAND

Cone Penetration Testing for Evaluating the Liquefaction Potential of Sands.
W90-00125 8D

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

SAND FILTERS

Filtration Studied with Endoscopes.
W90-00419 5F

Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

SASKATCHEWAN

Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

SATELLITE TECHNOLOGY

Statistical Rain Attenuation Prediction Model with Application to the Advanced Communication Technology Satellite Project. I--Theoretical Development and Application to Yearly Predictions for Selected Cities in the United States.
W90-00094 2B

Observations of Concurrent Drifting Buoy and Current Meter Measurements in Lake Michigan.
W90-00839 2H

Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

SAUDI ARABIA

Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

SAVANNAS

Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

SCANNING ELECTRON MICROSCOPY

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

SCENEDESMUS
Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

SCHEDULING
Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

SCOTLAND
Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

SEA OF JAPAN
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

SEALS
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

SEAWATER
Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

SECONDARY WASTEWATER TREATMENT
Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

SEDIMENT CONTAMINATION
Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

SEDIMENT CONTROL
Cohesive Sediment Transport: II. Application.
W90-00631 2L

SEDIMENT DISCHARGE
Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

SEDIMENT EROSION
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

SEDIMENT LOAD
Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

SEDIMENT SAMPLER
Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

SEDIMENT SORTING
Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

SEDIMENT TRANSPORT
Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

Validity and Limitations of Different Transport Models with Particular Reference to Sediment Transport.
W90-00011 2J

Surficial and Subsurface Distribution of Aquifer Sediments at the Bemidji, Minnesota, Research Site.
W90-00033 2F

Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

Streamflow, Sediment Transport, and Nutrient Transport at Incline Village, Lake Tahoe, Nevada, 1970-73.
W90-00219 2E

Transport and Sedimentation of Suspended Matter in Obstructed and Unobstructed Running Waters, (Transport-und Sedimentationsverhalten von Suspensa in Ungestauten und Gestauten Fliessgewaessern).
W90-00259 2J

Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

SEDIMENT-WATER INTERFACES
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

SEDIMENT YIELD
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

SEDIMENTATION
Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

Cohesive Sediment Transport: II. Application.
W90-00631 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

SEDIMENTATION RATES
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

SEDIMENTOLOGY
Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

SEDIMENTS
Clay Mineralogy of Sediments Associated with a Plume of Creosote-Contaminated Ground Water.
W90-00023 2K

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

SEEDLINGS
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

SEEPAGE
Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

Improvements in Soil Absorption Trench Design.
W90-00665 5D

Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

SEEPAGE CONTROL
Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

SELENIUM
Review of the Selenium Health Criteria Document.
W90-00090 5G

Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

SEMIARID LANDS
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

SEMIPERMEABLE MEMBRANES
Wettable Porous Plastic for Use as a Porous Barrier in Soil Hydraulic Studies.
W90-00389 2G

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

SEPARATION TECHNIQUES
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/

2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

SEPTIC TANKS
Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

Evaluation of Septic Tanks Performance in Some Parts of Mosul City in Iraq.
W90-00546 5D

SETTLEABLE SOLIDS
Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

SEVASTOPOL BAY
Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

SEWER SYSTEMS
Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

SHAD
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

SHELLFISH
Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

SHINER
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

SHORE PROTECTION
Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

SHREW
Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

SHRIMP
Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

SILT
Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

SILTING
Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

SILVER
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

SIMULATION
Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

Operation of Water Supply Reservoirs by 'Control Bands' Derived by Simulation.
W90-00941 4A

SIMULATION ANALYSIS
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

Simulation of Flood Hydrographs For Georgia Streams.
W90-00221 2E

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Review of Acid Rain Models for Europe.
W90-00233 5B

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

SITE SELECTION
Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

SLIP LININGS
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

SLOPE DEGRADATION
Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

SLUDGE
Dewatering Behaviour of Sewage Sludge with Inorganic and Macro-Molecular Means of Flocculation (Entwaesserungsverhalten eines Faulschlammes mit Anorganischen und Makromolekularen).
W90-00272 5D

Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

SLUDGE ANALYSIS
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

SLUDGE BED
Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

SLUDGE CONDITIONING
Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

SLUDGE DIGESTION
Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

SLUDGE DIGESTION

Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

SLUDGE DISPOSAL

Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

SLUDGE DRYING

Dewatering Behaviour of Sewage Sludge with Inorganic and Macro-Molecular Means of Flocculation (Entwaesserungsverhalten eines Faulschlammes mit Anorganischen und Makromolekularen).
W90-00272 5D

Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

Development and Design of Sludge Freezing Beds.
W90-00661 5E

SLUDGE FILTERS

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

SLUDGE SEEDING

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

SLUDGE UTILIZATION

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

SLURRIES

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

SMELT

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

SMOLT

Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

SNOW

Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

SNOW ACCUMULATION

Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

SNOW COVER

Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

SNOWMELT

Evolution of the Snow Cover and of the Soil Hydroiogical and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

SNOWPACK

Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

SOCIAL ASPECTS

Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 1.
W90-00081 6G

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 2.
W90-00082 6G

Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6G

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

SODIUM

Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

SOIL ABSORPTION CAPACITY

Cadmium Soil Sorption at Low Concentrations: VII, Effect of Stable Solid Waste Leachate Complexes.
W90-00802 5B

SOIL AMENDMENTS

Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

SOIL ANALYSIS

Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

SOIL BACTERIA

Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

SOIL CEMENT

Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

SOIL CHEMISTRY
Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

SOIL CLASSIFICATION
Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

SOIL COLUMNS
Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

SOIL CONSERVATION
Geology and Survival on the Snake River Plain.
W90-00335 5G

SOIL CONTAMINATION
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

SOIL ENGINEERING
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

SOIL EROSION
Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Filtration Behaviour of Soil Filters (Filtrationsverhalten und Bemessung von Erdstoff-Filtern).
W90-00189 8D

Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

Geology and Survival on the Snake River Plain.
W90-00335 5G

Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

SOIL FILTERS
Filtration Behaviour of Soil Filters (Filtrationsverhalten und Bemessung von Erdstoff-Filtern).
W90-00189 8D

SOIL FUNGI
Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

SOIL GASES
Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

SOIL HORIZONS
Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

SOIL MANAGEMENT
Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

SOIL MECHANICS
Cone Penetration Testing for Evaluating the Liquefaction Potential of Sands.
W90-00125 8D

SOIL MOISTURE DEFICIENCY
Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

SOIL MOISTURE RETENTION
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

Detection of Moisture Stress by Indicator Plots--A Simulation.
W90-00574 2I

SOIL ORGANIC MATTER
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

SOIL ORGANISMS
Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

SOIL PHYSICAL PROPERTIES
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

SOIL POROSITY
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

SOIL PROFILES
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

SOIL PROPERTIES
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

SOIL RECLAMATION
Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

SOIL STABILITY
Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

SOIL TEMPERATURE
Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

SOIL TESTS
Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

SOIL TEXTURE
Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

SOIL TYPES
Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

SOIL WATER
Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Simple Empirical Model of Root Water Uptake.
W90-00355 2I

Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Wettable Porous Plastic for Use as a Porous Barrier in Soil Hydraulic Studies.
W90-00389 2G

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

Solute Movement Through Root-soil Environment.
W90-00885 2I

Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

SOIL-WATER-PLANT RELATIONSHIPS
Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

Simple Empirical Model of Root Water Uptake.
W90-00355 2I

Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Solute Movement Through Root-soil Environment.
W90-00885 2I

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

SOIL WATER POLLUTION
Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

SOIL WATER TABLE
Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

SOLAR RADIATION
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

SOLID WASTE DISPOSAL
Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

How to Monitor Groundwater at a Municipal Solid Waste Facility.
W90-00796 5A

SOLID WASTES
Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

SOLUBILITY COEFFICIENT
Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

SOLUTE TRANSPORT
Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

Solute Movement Through Root-soil Environment.
W90-00885 2I

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

SORGHUM
Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

SORPTION
Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Modeling Sorptive Processes in Laboratory Columns.
W90-00058 2K

Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

SOUTH CAROLINA
Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

SOYBEANS
Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

SPAIN
Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

SPARTINA
Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

SPATIAL DISTRIBUTION
Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

SPAWNING
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

SPECIES COMPOSITION
Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

SPECIFIC CONDUCTIVITY
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

SPECTROPHOTOMETRY
Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

SPHAEROTILUS
Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

SPILLWAYS
Spillway Performance Report, Mississippi, December.1982.
W90-00135 8B

Black Creek No. 53, Mississippi, May 1983: Spillway Performance Report.
W90-00156 8A

Kentucky, May 1984: Spillway Performance Report.
W90-00157 8A

Floodwater Retarding Structure No. 4, Misteguay Creek, Michigan: Spillway Performance Report for Flow of September 1985.
W90-00158 8A

SPOIL BANKS
Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

SPOIL DISPOSAL
Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

SPOKANE RIVER
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

SPORT FISHING
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

SPREADSHEETS
Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

SPRINGS
Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

SPRUCE
Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

SPRUCE TREES
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

ST LAWRENCE ESTUARY
Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

STABILIZATION LAGOONS
Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

STACY DAM
Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

STACY RESERVOIR
Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

STAGE TREATMENT
Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

STANDARDS
Development Document for Final Effluent Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category: Gold Placer Mine Subcategory.
W90-00096 5G

Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

STANDING CROPS
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

STATISTICAL ANALYSIS
Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

STATISTICAL METHODS
Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

STATISTICAL MODELS
Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

STEMFLOW
Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

STOCHASTIC ANALYSIS
Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

STOCHASTIC HYDROLOGY
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

STOCHASTIC MODELS
Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

STOCHASTIC PROCESS
Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

STORAGE CAPACITY
Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

STORAGE RESERVOIRS
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

STORM SEWERS
Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

STORM WATER
Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

STRAITS
Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

STRATIFICATION
Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

STRATIGRAPHY
Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

STREAM BANKS
Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

STREAM BIOTA
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

STREAM DISCHARGE
Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

STREAM FISHERIES
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

STREAM GAGES
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

STREAM POLLUTION
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

STREAMFLOW
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Techniques For Estimating Streamflow Characteristics in The Eastern And Interior Coal Provinces of the United States.
W90-00203 2E

Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

Streamflow, Sediment Transport, and Nutrient Transport at Incline Village, Lake Tahoe, Nevada, 1970-73.
W90-00219 2E

Influence of the 1982-83 Drought on River Flows in Hawke's Bay.
W90-00932 2E

Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

STREAMFLOW FORECASTING
Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

STREAMS
Indiana Water Quality 1986: Monitor Station Records--Rivers and Streams.
W90-00127 2E

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

STREPTOCOCCUS
Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

STRONTIUM
Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

STRONTIUM RADIOISOTOPES
Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

STRUCTURE-ACTIVITY RELATIONSHIPS
Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

STRUVITE
Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

SUBARCTIC ZONE
Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

SUBLETHAL EFFECTS
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

SUBMERGED PLANTS
Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

SUBSURFACE DRAINAGE
Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

SUBSURFACE WATER
Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

SUCCESSION
Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

SUCKER
PCBs and DDT in Saginaw Bay White Suckers.
W90-00485 5B

Population Size and Status of the Razorback Sucker in the Great River Basin, Utah and Colorado.
W90-00617 8I

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

SULFATES
Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

Sulfate.
W90-00168 5G

Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

SULFATES

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

SULFIDES

Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

SULFUR

Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

SULFUR DIOXIDE

Save the Rain.
W90-00066 5G

Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

SUPERFUND

Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

SURFACE FLOW

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

SURFACE-GROUNDWATER RELATIONS

Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

SURFACE RUNOFF

Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

SURFACE WATER

Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

SURFACTANTS

Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Water Solubility Enhancements of DDT and Trichlorobenzene by Some Surfactants Below and Above the Critical Micelle Concentration.
W90-00536 5B

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

SURVEYS

1986 Lake Powell Survey.
W90-00126 2J

SUSPENDED LOAD

Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

SUSPENDED SEDIMENTS

Transport and Sedimentation of Suspended Matter in Obstructed and Unobstructed Running Waters, (Transport-und Sedimentationsverhalten von Suspensa in Ungestauten und Gestauten Fliessgewaessern).
W90-00259 2J

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

SUSPENDED SOLIDS

Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

SUSPENSION

Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

SWAMPS

Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

SWEDEN

Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kaikningsprojektet Harskogen 1976-1986: Vattenkemisk och Bilogisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Pas-

kynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

SWEET PEPPER
Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

SYNERGISTIC EFFECTS
Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

SYNTHETIC COMPOUNDS
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

SYSTEMS ANALYSIS
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

TANK IRRIGATION
Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

TANZANIA
Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

TAR CREEK
Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

TECHNOLOGY TRANSFER
New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

TEMPERATE ZONE
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

TEMPERATURE
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

TERRACING
Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

TEST WELLS
Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

TESTING PROCEDURES
Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

TEXAS
Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

THAILAND
Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

THE NETHERLANDS
Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

Expectations for Water Level Deviations at the Delta Works: Zlerikzee (Netherlands), November 1981-February 1986 (Verwachtingen voor Water-Standsafwijkingen Deltawerken: Zierikzee November 1981-Februari 1986).
W90-00185 2L

Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

THEORETICAL ANALYSIS
Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

THERMAL PROPERTIES
Heat and Moisture Losses of Heated Rivers (Waerme und Feuchteabgabe Aufgeheizter Fluesse).
W90-00182 5B

THERMAL SPRINGS
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

THERMAL STRATIFICATION
Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

THERMAL STRESS
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

THERMAL WATER
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

THERMOCLINE
Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

THERMOCYCLOPS
Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

THERMODYNAMICS
Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

THIN LAYER CHROMATOGRAPHY
Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

THORIUM
Actinide Behavior in Natural Waters.
W90-00558 5B

THROUGHFALL
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

THRUST RESTRAINTS
Engineering Approach to Waterline Thrust Restraint.
W90-00795 8A

TIBER RIVER
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

TIDAL CURRENTS
Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

TIDAL FLATS
Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

TIDAL HYDRAULICS
Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

TIDAL MARSHES
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

TIDAL POWERPLANTS
From Experimental to Large Tidal Power Stations (20th Anniversary of the Kislogubsk Tidal Power Station).
W90-00787 8C

Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

TIDES
Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

TIGRIS RIVER
Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

TIN
Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

TISSUE ANALYSIS
Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

TOKUYAMA BAY
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

TOXIC WASTES
Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984.
W90-00052 5B

Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

TOXICITY
Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

Health and Environmental Effects Profile for Benzo(k)Fluoranthene.
W90-00236 5C

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Health and Environmental Effects Profile for Phthalic Acid Esters (PAEs).
W90-00253 5C

Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

TOXINS
Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

TRACE ELEMENTS
Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

TRACE LEVELS

Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

TRACE METALS

Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

TRACERS

Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

Algorithm for the Interpretation of Groundwater Field Experiments.
W90-00934 2F

Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

TRANSMISSIVITY

Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

TRANSPIRATION

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

TRAPPING

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

TREES

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

TRIBUTYLTIN

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

TRICKLE IRRIGATION

Head Loss in Manifolds or Trickle Lateral: Simplified Approach.
W90-00897 3F

TRICKLING FILTERS

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

TRIHALOMETHANES

Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

TRITIUM

Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

TROPHIC LEVEL

Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

TROPICAL REGIONS

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

TROUT

Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

Geology and Survival on the Snake River Plain.
W90-00335 5G

Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

TRUCKEE RIVER

Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

TUBIFICIDS

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

TULALIP AQUIFER

Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

TUNDRA

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

TUNGSTEN

Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

TURBIDIMETRY

Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

TURBIDITY

Turbidity and Color.
W90-00164 5G

TURBIDITY

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

TURBULENT FLOW

Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

TURKEY

Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

UNDERFLOW

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

UNDERGROUND STORAGE

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

UNDERGROUND WASTE DISPOSAL

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

UNITED KINGDOM

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

UPPER COLORADO RIVER BASIN

Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

URANIUM

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

Actinide Behavior in Natural Waters.
W90-00558 5B

URANIUM RADIOISOTOPES

Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

URBAN AREAS

Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

URBAN DRAINAGE

Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

URBAN HYDROLOGY

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

URBAN RUNOFF

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

URBANIZATION

Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

USSR

Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

From Experimental to Large Tidal Power Stations (20th Anniversary of the Kislogubsk Tidal Power Station).
W90-00787 8C

Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

VACUUM FILTRATION

Vacuum Operation for Overloaded Anaerobic Treatment Systems.
W90-00754 5D

VADOSE WATER

Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

Simple Empirical Model of Root Water Uptake.
W90-00355 2I

Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

VEGETABLE CROPS

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

VELOCITY

Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

VENEZUELA

Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

VENICE

Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

VENICE LAGOON

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

VERMONT

Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

VIBRIO

Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

VIRGINIA

Acid Deposition Program: Scope of Work.
W90-00072 5B

VOLATILE ORGANIC COMPOUNDS

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Point-of-Use/Point-of-Entry Systems for Removing VOCs from Drinking Water.
W90-00137 5F

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

VOLUTIN

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

VULNERABILITY

Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

WAKOOL RIVER
Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

WALES
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

WALLEYE
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

WARNING SYSTEMS
Status Report on Flood Warning Systems in the United States.
W90-00452 6F

WASH LOAD
Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

WASHINGTON
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

WASTE DISPOSAL
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Program Overview and Selected Papers from the Toxic-Waste Program Technical Meeting: Tucson, Arizona, March 20-22, 1984.
W90-00052 5B

Role of Geochemical Processes in Hazardous-Waste Studies.
W90-00053 5B

Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

Ground-Water Monitoring Compliance Projects for Hanford Site Facilities.
W90-00153 5G

Hazardous Materials: Microbiological Decomposition, January, 1978-August, 1988: Citations from the Life Sciences Collection Database.
W90-00178 5E

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

Groundwater Pollution and the Disposal of Hazardous and Radioactive Wastes.
W90-00926 5E

WASTE MANAGEMENT
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

WASTE TREATMENT
Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

WASTE UTILIZATION
Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

WASTEWATER
Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

WASTEWATER ANALYSIS
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

WASTEWATER DISPOSAL
Onsite Wastewater Disposal.
W90-00175 5D

Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

Improvements in Soil Absorption Trench Design.
W90-00665 5D

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

WASTEWATER FACILITIES
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

Nitrogen Removal Works Year-Round.
W90-00552 5D

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

WASTEWATER FARMING
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

WASTEWATER IRRIGATION
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

WASTEWATER LAGOONS
Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

WASTEWATER MANAGEMENT
Wastewater Management in the Automobile Industry.
W90-00769 5D

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

WASTEWATER OUTFALL
Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

WASTEWATER OXIDATION
Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

WASTEWATER POLLUTION
Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

WASTEWATER REACTORS
Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

WASTEWATER RENOVATION
Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

WASTEWATER TREATMENT
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Onsite Wastewater Disposal.
W90-00175 5D

Water and Wastewater Finance and Pricing.
W90-00176 5D

Gassing of Biosuspensions in Bubble Column and Loop Reactors (Begasung von Blosuspensionen in Blasensaeuien und Schiaufenreaktoren).
W90-00190 5D

Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Demonstration and Evaluation of the Captor Process for Sewage Treatment.
W90-00254 5D

Investigations on Treatment of Wastewater and Sludge, Nitrification and Reduction of Phosphates in Lime Pre-precipitation with Subsequent Aerobic Stabilization (Untersuchungen zur Abwasser-und Schlamm-hygienisierung, Nitrifikation und Phosphatverminderung bei der Kalkvorfallung mit Nachfolgender aerober Stabilisierung).
W90-00258 5D

Development and Investigation of a Process for the Electrochemical Treatment of Wastewater (Entwicklung und Untersuchung eines Verfahrens zur Elektrochemischen Aufbereitung von Abwasser).
W90-00268 5D

Dewatering Behaviour of Sewage Sludge with Inorganic and Macro-Molecular Means of Flocculation (Entwaesserungsverhalten eines Faulschlammes mit Anorganischen und Makromolekularen).
W90-00272 5D

Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

Filtration Studied with Endoscopes.
W90-00419 5F

Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

Removal of Copper From Solution Using Moss.
W90-00496 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

Electrobiological Wastewater Treatment.
W90-00529 5D

Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

Evaluation of Septic Tanks Performance in Some Parts of Mosul City in Iraq.
W90-00546 5D

Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

Nitrogen Removal Works Year-Round.
W90-00552 5D

Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

Development and Design of Sludge Freezing Beds.
W90-00661 5E

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

Improvements in Soil Absorption Trench Design.
W90-00665 5D

Get Control of Your Activated Sludge Process.
W90-00667 5D

Spinning Air Blasts Operating Costs.
W90-00668 5D

Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Siudge Aeration Tank.
W90-00750 5D

Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

Vacuum Operation for Overloaded Anaerobic Treatment Systems.
W90-00754 5D

Effects of Thermal Pretreatment of Sewage Sludge on Anaerobic Digestion.
W90-00755 5D

Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

Wastewater Management in the Automobile Industry.
W90-00769 5D

Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

Role of Acetate in Denitrification and Biological Phosphate Removal in Modified Bardenpho Systems.
W90-00780 5D

Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

New Method of Design of Steam-Distillation Treatment of Wastewater.
W90-00837 5D

Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Chromatography for Water Pollution Analysis, January, 1977-October, 1988: Citations from the Energy Data Base.
W90-00256 5A

Determination of Fluoride Ions in Water by Conductometric Titration with Lanthanum Nitrates (Determinacao de Ions Fluoreto em Aguas, por Titulacao Condutometrica com Nitrato de Lantanio).
W90-00274 5A

Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

Analytical Chemistry for Environmental Sciences.
W90-00542 5A

Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmos-

pheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

WATER CHEMISTRY

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

Central Asian Irrigation Canals and some Aspects of their Algal Flora.
W90-00408 2H

Analytical Chemistry for Environmental Sciences.
W90-00542 5A

Actinide Behavior in Natural Waters.
W90-00558 5B

Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

WATER CIRCULATION

Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

WATER CONSERVATION

Wellton-Mohawk Farmers Deliver Water Conservation.
W90-00325 3F

Directions in Water Conservation and Management in Massachusetts.
W90-00651 3D

Overview of the MWRA Water Conservation Program.
W90-00652 3D

WATER CONVEYANCE

Heavy Metals in Drinking Water: Standards, Sources, and Effects, January, 1978-September, 1988: Citations from the Life Sciences Collection Database.
W90-00179 5F

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

WATER CURRENTS

Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

Simulation of Wind-induced Water Currents.
W90-00632 2H

Observations of Concurrent Drifting Buoy and Current Meter Measurements in Lake Michigan.
W90-00839 2H

WATER DEMAND

Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

WATER DISTRIBUTION

Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

WATER HYACINTH

Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

WATER LAW

Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

WATER LEVEL

Expectations for Water Level Deviations at the Delta Works: Zlerikzee (Netherlands), November 1981-February 1986 (Verwachtingen voor Water-Standsafwijkingen Deltawerken: Zierikzee November 1981-Februari 1986).
W90-00185 2L

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

WATER LEVEL FLUCTUATIONS

Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

WATER LEVEL FORECASTING
Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

WATER LEVEL RECORDERS
Expectations for Water Level Deviations at the Delta Works: Zierikzee (Netherlands), November 1981-February 1986 (Verwachtingen voor Water-Standsafwijkingen Deltawerken: Zierikzee November 1981-Februari 1986).
W90-00185 2L

WATER MANAGEMENT
Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

Overview of the MWRA Water Conservation Program.
W90-00652 3D

Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

WATER POLICY
Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Directions in Water Conservation and Management in Massachusetts.
W90-00651 3D

WATER POLLUTION
Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

Electrode system for Determination of Microbial Cell Populations in Polluted Water.
W90-00397 5A

Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

Mercury Pollution in Tokuyama Bay.
W90-00711 5B

Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

WATER POLLUTION CONTROL
Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Field Data Acquisition Systems.
W90-00021 7B

Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

Save the Rain.
W90-00066 5G

Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

Acid Deposition Research and Policy.
W90-00069 5B

Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

Acid Deposition Program: Scope of Work.
W90-00072 5B

Wisconsin Acid Deposition Program.
W90-00073 5G

What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

EPA: Ground Water Handbook.
W90-00087 5G

Development Document for Final Effluent Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category: Gold Placer Mine Subcategory.
W90-00096 5G

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume I.
W90-00132 5A

Installation Restoration Program Phase II--Confirmation Quantification, Stage 2. Volume II.
W90-00133 7C

Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

Diversion Project Alleviates Saltwater Intrusion.
W90-00798 5G

WATER POLLUTION EFFECTS
Developments in Ecological Modelling.
W90-00003 7C

Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Florida Acid Deposition Research Program.
W90-00068 5C

Field Assessment of the Effects of Contaminants on Fishes.
W90-00083 5C

Health and Environmental Effects Profile for Pyrene.
W90-00089 5C

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

Acid Precipitation: Effects on Fresh Water Ecosystems, January, 1978-September 1988: Citations from the Life Sciences Collection Database.
W90-00192 5C

Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

Health and Environmental Effects Profile for Niagara Blue 4B.
W90-00247 5C

Health and Environmental Effects Profile for Phthalic Acid Esters (PAEs).
W90-00253 5C

Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter

av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

WATER POLLUTION PREVENTION

Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

Groundwater Pollution and the Disposal of Hazardous and Radioactive Wastes.
W90-00926 5E

WATER POLLUTION SOURCES

Agricultural Nonpoint Source Pollution: Model Selection and Application.
W90-00001 5B

Some Aspects of Soil Erosion Modelling.
W90-00009 2J

Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

Mine-Water Discharge, Metal Loading, and Chemical Reactions.
W90-00039 5B

Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

Overview of Organic Compounds in Ground Water.
W90-00054 5B

Acid Rain 1986: A Handbook for States and Provinces.
W90-00063 5B

Pollutants in the Air and Acids in the Rain: Influences on Our Natural Environment and a Challenge for Every Industrial Society.
W90-00064 5B

Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

Health and Environmental Effects Profile for Phenanthrene.
W90-00239 5C

Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

Water Solubility Enhancements of DDT and Trichlorobenzene by Some Surfactants Below and Above the Critical Micelle Concentration.
W90-00536 5B

Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

Actinide Behavior in Natural Waters.
W90-00558 5B

Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

Aquatic Pollution in the Far East.
W90-00739 5B

Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

WATER POLLUTION TREATMENT

Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

Superfund Record of Decision (EPA Region 2) Love Canal, Niagara Falls, New York, October 1987. Second Remedial Action.
W90-00235 5G

Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

WATER POTENTIALS

Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

WATER QUALITY

Indiana Water Quality 1987: Monitor Station Records, Rivers and Stream.
W90-00079 5B

Indiana Water Quality 1986: Monitor Station Records--Rivers and Streams.
W90-00127 2E

Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

Quality of Ground Water in Idaho.
W90-00202 2F

Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

Flow Cytometry for Algal Studies.
W90-00903 7B

Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

WATER QUALITY CONTROL

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs): 1987 Review of the Draft Final.
W90-00085 5G

Review of the Selenium Health Criteria Document.
W90-00090 5G

Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources.
W90-00163 5G

Turbidity and Color.
W90-00164 5G

Total Dissolved Solids.
W90-00165 5G

Chloride.
W90-00166 5G

Magnesium.
W90-00167 5G

Sulfate.
W90-00168 5G

Arsenic.
W90-00169 5G

Cyanide.
W90-00170 5G

Lindane.
W90-00171 5G

Algae and Associated Aquatic Bacteria.
W90-00172 5G

Research Recommendations.
W90-00173 5G

Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

Technical and Economic Data Development Concerning the LUST Program.
W90-00249 5G

Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

WATER QUALITY CONTROL

Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

Urban Groundwater Rise Control: Case Study.
W90-00884 4C

WATER QUALITY MANAGEMENT

Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

Development and Application of a Model for Regional Water Quality Management.
W90-00835 5G

River Quality Modeling: Time Domain Approach.
W90-00889 5B

WATER QUALITY MODELS

River Quality Modeling: Time Domain Approach.
W90-00889 5B

WATER QUALITY STANDARDS

Evaluation of Military Field-Water Quality. Volume 4. Health Criteria and Recommendations for Standards. Part 1: Chemicals and Properties of Military Concern Associated with Natural and Anthropogenic Sources.
W90-00163 5G

Drinking Water Standards and Risk Assessment.
W90-00922 5G

WATER RESOURCES

Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

WATER RESOURCES DATA

Need for Climatic and Hydrologic Data in Agriculture in Southeast Asia.
W90-00100 7A

Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

Minimum Data Sets: Hydrological Applications.
W90-00103 3F

Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

Estimating Climatic Data.
W90-00105 7C

Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

Decision Making Using a Drought Severity Index.
W90-00110 6A

Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Assessment of Rainfall Erosion Hazard.
W90-00113 2J

Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

Bureau's Data Bank--How It Works.
W90-00119 7C

Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

Quality of Ground Water in Idaho.
W90-00202 2F

Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

WATER RESOURCES DEVELOPMENT

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 1.
W90-00081 6G

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 2.
W90-00082 6G

Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

River Quality Modeling: Time Domain Approach.
W90-00889 5B

WATER RESOURCES INSTITUTES

Water Research in Australia: Current Projects 1987.
W90-00146 9C

Water Research in Australia: Current Projects 1988.
W90-00147 9C

WATER RESOURCES MANAGEMENT

Glen Canyon Environmental Studies: Executive Review Committee Final Report.
W90-00095 6G

Side Effects of Water Resources Management.
W90-00160 6G

Research Needs in Irrigation and Drainage--1989.
W90-00893 3F

WATER REUSE

State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

WATER SAMPLING

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

WATER SHORTAGE

Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

WATER STORAGE

Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

WATER STRESS

Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

WATER SUPPLY
Resource Document: For the Consideration of the Tulalip Aquifer as a Sole Source Aquifer.
W90-00144 2F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

Overview of the MWRA Water Conservation Program.
W90-00652 3D

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

Economic Impact of Micro Catchment Development.
W90-00882 4A

River Quality Modeling: Time Domain Approach.
W90-00889 5B

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

Operation of Water Supply Reservoirs by 'Control Bands' Derived by Simulation.
W90-00941 4A

WATER SUPPLY DEVELOPMENT
New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

WATER TABLE GRADIENT
Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

WATER TANKS
Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

WATER TEMPERATURE
Heat and Moisture Losses of Heated Rivers (Waerme und Feuchteabgabe Aufgeheizter Fluesse).
W90-00182 5B

Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

WATER TRANSFER
Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

WATER TREATMENT
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Point-of-Use/Point-of-Entry Systems for Removing VOCs from Drinking Water.
W90-00137 5F

Water and Wastewater Finance and Pricing.
W90-00176 5D

Health Effects of Drinking Water Treatment Technologies.
W90-00177 5F

Comparisons of Various Filtration Media.
W90-00238 5F

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

Pump-Control Valves Protect Your Water System.
W90-00669 5F

Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

Aqueous Chlorination of Permethrin.
W90-00914 5F

Drinking Water Standards and Risk Assessment.
W90-00922 5G

WATER TREATMENT FACILITIES
Advanced Information System of Waterworks, (in Japanese).
W90-00255 5F

Filtration Studied with Endoscopes.
W90-00419 5F

Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

WATER USE
Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

WATER YIELD
Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

WATERFOWL
Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

WATERLOGGING
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

WATERSHEDS
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

WAVE ACTION
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

WAVE VELOCITY
Simulation of Wind-induced Water Currents.
W90-00632 2H

WEATHERING
Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

WEED CONTROL
Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

WEIRS
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

WELL HYDRAULICS
Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

WELL SCREENS
Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

WELL WATER
Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

WELLS
Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

WEST GERMANY
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

WET OXIDATION PROCESS
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

WETLANDS
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

Photosynthesis of Salt Marsh Species.
W90-00605 2H

Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

WHEAT
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

WHITEFISH
Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

WILDLIFE HABITATS
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

WILDLIFE MANAGEMENT
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

WIND
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

WIND-DRIVEN CURRENTS
Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

Simulation of Wind-induced Water Currents.
W90-00632 2H

WIND EROSION
Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

WIND VELOCITY
Simulation of Wind-induced Water Currents.
W90-00632 2H

WISCONSIN
Wisconsin Acid Deposition Program.
W90-00073 5G

Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

Nitrogen Removal Works Year-Round.
W90-00552 5D

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

WYOMING
Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

Synoptic and Meso-Alpha Scale Meteorology of Wyoming Flash Floods.
W90-00237 2B

YANGTZE RIVER
Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

YEASTS
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

ZIMBABWE
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

ZINC
Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

ZOOPLANKTON

Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

AUTHOR INDEX

ABBAS, M. N.
Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

ABBASI, S. A.
Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

ABDEL-MONIEM, S.
Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

ABERG, G.
Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

ABO-ELELA, S. I.
Wastewater Management in the Automobile Industry.
W90-00769 5D

ABRAHAMS, P. W.
Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

ABROL, I. P.
Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

ABU-RIZAIZA, O. S.
Urban Groundwater Rise Control: Case Study.
W90-00884 4C

ACHIK, J.
Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

ACTON, D. F.
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

ADAMAS, J. R.
Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

ADAMS, F. C.
Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

ADAMS, M. S.
Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

ADIN, A.
Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

ADLER, A.
Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

ADRIAANSE, A.
Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

AGRAWAL, Y. K.
Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

AGUA, M. M.
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

AHLF, W.
Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

AHMED, M.
Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

AINSWORTH, L. D.
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

AITKEN, A. P.
Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

AITKEN, M. D.
Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

AIZAKI, M.
Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

AJMAL, M.
Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

AK'HABUHAYA, J.
Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

AKAN, A. O.
Time of Concentration Formula for Pervious Catchments.
W90-00895 2G

AL-ASSY, N. B.
Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

AL-JASIM, A. A.
Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

AL-LAYLA, M. A.
Evaluation of Septic Tanks Performance in Some Parts of Mosul City in Iraq.
W90-00546 5D

AL-LAYLA, R. I.
Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

AL-MOMANI, I. F.
Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

AL-NOAIM, A. A.
Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

AL-OGAILY, N. H.
Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

AL-OMAR, M. A.
Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

AL-RAWI, E. H.
Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

AL-RAWI, S. M.
Evaluation of Septic Tanks Performance in Some Parts of Mosul City in Iraq.
W90-00546 5D

AL-SHAHWANI, M. F.
Bacterial Extracellular Material from Brewery Wastewater for Raw Water Treatment.
W90-00532 5F

AL-TAHIR, O. A.
Effect of Drainage Water on Nodulation, Nitrogen Fixation and Growth of Faba Bean.
W90-00535 2I

ALAFOUSOU, P.
Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

ALASAARELA, E.
Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

ALAVERDYAN, R. A.
Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

ALBAIGES, J.
Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

ALBASEL, N.
Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

ALBASEL, N.

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

ALBERTI, J.
Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

ALBERTS, J. J.
Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

ALDRIDGE, B. N.
Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

ALEKSANDRYAN, V. V.
Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

ALENAES, I.
Liming Project Haerskogen 1976-1986: Water Chemical and Biologic Response on Liming in Seven West Swedish Lakes (Kalkningsprojektet Harskogen 1976-1986: Vattenkemisk och Biologisk Respons pa kalkningsatgarder i sju Vastsvenska Sjoar).
W90-00270 5G

ALEXANDER, M.
Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

ALFONSI, J. M.
Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

ALGOZIN, K. A.
Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

ALI, H. I.
Wastewater Management in the Automobile Industry.
W90-00769 5D

ALI, I.
Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

ALI KHAN, M. Z.
Urban Groundwater Rise Control: Case Study.
W90-00884 4C

ALKSNIS, H.
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

ALLISON, G. B.
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

ALUMBAUGH, D.
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

ALVES, J. C.
Determination of Fluoride Ions in Water by Conductometric Titration with Lanthanum Nitrates (Determinacao de Ions Fluoreto em Aguas, por Titulacao Condutometrica com Nitrato de Lantanio).
W90-00274 5A

AMBROSE, R. B.
Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

AMY, G. L.
Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

ANDERSON, G. S.
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

ANDERSON, J. K.
Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

ANDERSON, J. W.
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

ANDERSON, L.
Soil Moisture Deficits in South-Central Sweden: II. Trends and Fluctuations.
W90-00921 2G

ANDERSON, L. E.
Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

ANDERSON, W. P.
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

ANDERSSON, L.
Soil Moisture Deficits in South-Central Sweden: I. Seasonal and Regional Distributions.
W90-00920 2G

ANDRAS, E.
Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

ANDRLE, W.
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

ANGLE, J. A.
Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

ANGUS, J. F.
Simulation Model for Multiple Crops in a Rainfed Rice-Based Cropping System.
W90-00116 2B

ANKLEY, G. T.
Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

ANNELIN, R. B.
Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

AOKI, S.
Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

AOKI, T.
Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

APPERLEY, L. W.
Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

ARAKEL, A. V.
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

ARFI, R.
Annual Cycles and Budget of Nutrients in Berre Lagoon (Mediterranean Sea, France).
W90-00405 2L

ARGESE, E.
Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

ARIMOTO, R.
Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

ARMSTRONG, A. S. B.
Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

ARNDT, J. L.
Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

ARP, P. A.
Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

ARTAN, N.
Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

ARTHUR, M. F.
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

ARTZ, R. S.
Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

ARUN, V.
Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

ARVANITOYANNIS, I.
Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

ASANOV, A. Y.
Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

ASH, E. G. M.
Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

ASMAN, W. A. H.
Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

ASSAS, M. N.
Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

ASTON, G. H. R.
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

ATCHLEY, T. L.
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

AUDIC, M. M.
Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

AUSTIN, A.
Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

AYADI, H.
Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

AZAM-ALI, S. N.
Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

AZIZ, K. M. S.
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

AZIZ, N. M.
Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

BACHMANN, R. W.
In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

BACKLUND, P.
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

BAECKER, A. A. W.
Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

BAEDECKER, M. J.
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

BAGGALEY, R.
Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

BAHNICK, D.
Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

BAHR, J. M.
Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

BAIER, J. H.
Point-of-Use/Point-of-Entry Systems for Removing VOCs from Drinking Water.
W90-00137 5F

BAILEY, S. K.
Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

BAIRLEIN, F.
Respiration of Chironomus Larvae (Diptera) from Deep and Shallow Waters Under Environmental Hypoxia and at Different Temperatures.
W90-00595 2H

BAKALOWICZ, M.
Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

BAKER, D.
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

BAKER, E. G.
Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

BAKER, G. C.
Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

BALDERSON, R. K.
Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

BALES, R. C.
Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

BALOPOULOS, E. T.
Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

BANANZINGA, P.
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

BANTON, O.
Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

BARBARICK, K. A.
Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

BARBER, L. B.
Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

BARBIER, E.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

BARBITTA, J. A.
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

BARFIELD, B. J.
Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

BARGAGLI, R.
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

BARGHIGIANI, C.
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

BARRASH, W.
Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

BARRY, R.
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

BARTARYA, S. K.
Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

BARTLE, G. A.
Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

BARTLETT, K. B.
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

BASAGUREN, A.
Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

BASSERES, A.
Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

BASTIEN, C.
Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris

BASTIEN, C.

(Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

BAUDIN, J. P.
Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

BAUDO, R.
Uncertainty in Description of Sediment Chemical Composition.
W90-00731 7B

BAUER, I.
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

BAY, S. M.
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

BEASLEY, D. B.
Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

BEAUVILLAIN, E.
Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

BECK, J. N.
Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

BECKERT, W. F.
Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

BECKETT, R.
Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

BEERSING, A. K.
Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

BELLOT, J.
Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

BELZLLE, N.
Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

BEN-HARIM, I.
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

BENDORICCHIO, G.
Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

BENES, P.
Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

BENFIELD, E. F.
Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

BENGTSON, J.
Pump-Control Valves Protect Your Water System.
W90-00669 5F

BENNETT, G. F.
Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

BENNETT, P. C.
Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

BENOIST, A. P.
Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

BENSON, L. J.
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

BENSON, S. M.
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

BENSON, W. H.
Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

BERG, W. A.
Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

BERGMAN, A.
Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

BERGMAN, M.
Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

BERKOWITZ, B.
Boundary Conditions Along Permeable Fracture Walls: Influence on Flow and Conductivity.
W90-00956 2F

BERMEJO BARRERA, A.
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

BERMEJO BARRERA, P.
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

BERMEJO MARTINEZ, F.
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

BERNDT, M. P.
Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

BERNSHTEIN, L. B.
From Experimental to Large Tidal Power Stations (20th Anniversary of the Kislogubsk Tidal Power Station).
W90-00787 8C

BERSHTEIN, L. B.
Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

BERTRAND, J. C.
Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

BETTANDORFF, J. M.
Techniques For Estimating Streamflow Characteristics in The Eastern And Interior Coal Provinces of the United States.
W90-00203 2E

BEVANS, H. E.
Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

BEVERAGE, J. P.
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

BEZRUKOV, L. B.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

BHOWMIK, N. G.
Successional Changes in Habitat Caused by Sedimentation in Navigation Pools.
W90-00697 2J

BHUIYAN, S. I.
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

Gravity Irrigation Management in Bangladesh.
W90-00887 3F

BIANCHI, A.
Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

BIANCHI, M.
Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

BIANCHIL, N.
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

BIANCHINI, A. G.
Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

BIDLEMAN, T. F.
Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

BIGGAR, J. W.
River Quality Modeling: Time Domain Approach.
W90-00889 5B

BILLEN, G.
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

BIRYUKOVA, T. A.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

BJOERNDAL, H.
Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

BLACKBURN, J. W.
Improved Understanding and Application of Hazardous Waste Biological Treatment Processes Using Microbial Systems.
W90-00465 5D

BLACKWOOD, I. L.
Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

BLANC, G.
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

BLAZQUEZ, R.
Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

BLEIL, D. F.
Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

BLUM, L. K.
Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

BLUNDO, C. M.
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

BOBBA, A. G.
Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

BOCQUILLON, C.
Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

BODINE, M. W.
Clay Mineralogy of Sediments Associated with a Plume of Creosote-Contaminated Ground Water.
W90-00023 2K

BOETTCHER, A. J.
Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

BOIKOVA, I. G.
Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

BOLOGA, A. S.
Present State of Seaweed Production along the Romanian Black Sea Shore.
W90-00673 2L

BOLTE, M.
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

BOMAN, B. J.
LP Operation Model for On-demand Canal Systems.
W90-00891 3F

BOND, W. J.
Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

BONET, A.
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

BONOTTO, D. M.
Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

BORDACS, K.
Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

BORGHETTI, M.
Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

BORKAN, R. E.
Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

BORSCH, D. D.
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

BOSS, R.
Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

BOSSONG, C. R.
Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

BOSTON, H. L.
Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

BOSTWICK, T. W.
Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

BOURALY, M.
Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

BOUWER, E. J.
Biotransformation of Aromatics in Strip-Pit Pond.
W90-00657 5B

BOUWER, H.
Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

BOWEN, J. D.
Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

BOWERSOX, V. C.
Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

BOWES, G.
Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

BOYCE, F. M.
Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

BOYLE, M.
Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

BRADFORD, W. L.
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

BRAKKE, D. F.
'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

BRALTS, V. F.
Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

BRAND, D.
Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

BRANDT, I.
Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

BRANNON, J. M.
Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

BRASINO, T. L.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

BRIENS, P. J.
Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

BRINKKEMPER, O.
Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

BRINKMAN, J.
Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

BRINKMANN, P. J.
Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

BRIX, H.
Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

BROCHU, C.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

BROOKS, K. D.
Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

BROWN, E. J.
Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

BROWN, M. P.
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

BRUNI, V.
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

BRUNNER, P. H.
Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

BRUSSEAU, M. L.
Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

BRYANT, C. W.
Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

BRYDGES, T. G.
Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

BUCHBERGER, S. G.
Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

BUCK, J. D.
Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

BUDNEV, N. M.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

BUIJSMAN, E.
Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

BUISHAND, T. A.
Partial Duration Series Method with a Fixed Number of Peaks.
W90-00573 2E

BUKATA, R. P.
Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

BULLIVANT, D. P.
Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

BUONACCORSI, G.
Flow Cytometry for Algal Studies.
W90-00903 7B

BURGER, J. S.
Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

BURKE, E. M.
Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

BURKHOLDER, J. M.
Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

BURTON, J. E.
Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

BUSCH, W. N.
Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

BUSHONG, S. J.
In Situ Nutrient Enrichment Experiments with Periphyton in Agricultural Streams.
W90-00401 4C

BUSONI, E.
Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

BUSS, J.
Hydraulic Calculations for Flow Under Dikes on Consolidated Beds (Untergrundhydraulische Berechnungen an Flussdeichen auf Bindigen Deckschichten).
W90-00257 2F

BUTIN, N. P.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

BUTLER, D. R.
Snow Avalanche-Dams and Resultant Hazards in Glacier National Park, Montana.
W90-00621 2C

BUTNER, R. S.
Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

BUTTERWORTH, B. C.
Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

BUTTY, A. N.
Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

CACHO, M.
Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

CADENA, F.
Use of Tailored Bentonite for Selective Removal of Organic Pollutants.
W90-00658 5D

CAI, J. P.
Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

CALLANDER, S. J.
Vibration on Rectangular Bars Due to Flow (Storemungsbedingte Schwingungen von Rechteckstaeben).
W90-00188 8B

CALMANO, W.
Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

CAMPANELLA, L.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

CAMPBELL, J. A.
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

CANCILLA, D.
Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

CANGAMELLA, F.
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

CANTOR, K. P.
Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

CANTRELL, D.
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

CAPEHART, A. A.
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

CAPEL, P. D.
Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

CAPONE, D. G.
Analytical Chemistry for Environmental Sciences.
W90-00542 5A

CAPPENBERG, T. E.
Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

CAPRAIS, J. C.
Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

CARBON, B. A.
Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

CARDINALI, F. L.
Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

CAREY, M. A.
Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

CARIGNAN, R.
Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

CARLIER, E.
Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

CARMICHAEL, G. R.
Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

CARSEL, R. F.
Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

CARTER, J. L.
Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

CARTER, R. R.
Cone Penetration Testing for Evaluating the Liquefaction Potential of Sands.
W90-00125 8D

CASTRITSI-CATHARIOS, J.
Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

CATOGGIO, J. A.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

CAUMETTE, P.
Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

CAVARI, B.
Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

CAWLFIELD, J. D.
Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

CEAZAN, M. L.
Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

CENTOLELLA, P. A.
Legislating a Fair and Effective National Acid Deposition Control Program: An Ohio Perspective.
W90-00071 5G

CERNIGLIA, C. E.
Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

CESARONI, D.
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

CHAI, T.-J.
Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

CHAKRABORTI, D.
Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

CHALANCHUK, S. M.
Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

CHAMP, M. A.
Research Needs Concerning Organotin Compounds Used in Antifouling Paints in Coastal Environments.
W90-00142 5C

CHAN, G. Y. S.
Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

CHANEY, T. H.
Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

CHANG, A. C.
Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

CHANG, F. H.
Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

CHANG, J.
Treatment of Landfill Leachate with an Upflow Anaerobic Reactor Combining a Sludge Bed and a Filter.
W90-00758 5G

CHANG, Y. S.
Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

CHAO DE BAEZ, C.
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

CHAPMAN, P. M.
Current Approaches to Developing Sediment Quality Criteria.
W90-00311 5A

CHAPMAN, T. G.
Use of Residence Time Distribution in Agroclimatic Classification.
W90-00107 2B

CHAPPELLE, F. H.
Role of Geochemical Processes in Hazardous-Waste Studies.
W90-00053 5B

CHATSANGUTHAI, S.
Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

CHAUHAN, H. S.
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

CHAWLA, G.
Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

CHEN, J.
Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

CHEN, Y. H.
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

CHERKAUER, D. S.
Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

CHERNYY, S. G.
Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

CHEUNG, Y. H.
Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

CHIESA, S. C.
Carbon Flow Patterns in Enhanced Biological Phosphorus Accumulating Activated Sludge Cultures.
W90-00781 5D

CHILDERS, D. L.
Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

CHILTON, P. J.
Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

CHIN, A. K.
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

CHIN, K. K.
Post Treatment of Anaerobic Effluent Using Sequencing Batch Reactors.
W90-00748 5D

CHINOY, P. D.
Engineering Approach to Waterline Thrust Restraint.
W90-00795 8A

CHIOU, C. T.
Capacities and Mechanisms of Sorption of Organic Compounds by Water-Saturated and Unsaturated Soils.
W90-00056 5B

Water Solubility Enhancements of DDT and Trichlorobenzene by Some Surfactants Below and Above the Critical Micelle Concentration.
W90-00536 5B

CHIU, S. Y.
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

CHO, S.
Evaluation of the Effect of Reductions in Ambient Levels of Primary Pollutants on Sulfate and Nitrate Wet Deposition.
W90-00346 5B

CHOHJI, T.
Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

CHOI, C. C.
Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

CHOPPIN, G. R.
Actinide Behavior in Natural Waters.
W90-00558 5B

CHOWDHURY, M. A. R.
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

CHRISTENSEN, P. B.
Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

CHRISTENSEN, T. H.
Cadmium Soil Sorption at Low Concentrations: VII, Effect of Stable Solid Waste Leachate Complexes.
W90-00802 5B

CHUI, V. W. D.
Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

CHURCH, T. M.
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

CIFUENTES, L. A.
Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

CIMSIT, Y.
Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

CLADERA, A.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

CLARK, G.
Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

CLARK, M. J. R.
Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

CLEMENT, R. L.
Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

CLINE, S. M.
Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

CLITES, A. H.
Observations of Concurrent Drifting Buoy and Current Meter Measurements in Lake Michigan.
W90-00839 2H

CLOERN, J. E.
Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

CLOOS, P.
Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

CLOPPER, P. E.
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

CLOUGH, K. S.
Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

CLOUTIER, R.
Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

CODELL, R. B.
Hydrologic Design for Riprap on Embankment Slopes.
W90-00084 8D

COLEMAN, G. A.
Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

COLLETT, J.
Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

COLLINS, B. D.
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

COLLINS, M. R.
Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

COLMAN, B.
Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

COLOMBO, J. C.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

COLWELL, R. R.
Effect of Pollution on the Bacterial Community Structure in the Coastal Waters of the Eastern Mediterranean Sea.
W90-00286 5C

CONNOR, T. B.
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

CONSTABLE, G. A.
Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

CONTRACTOR, D. N.
Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

COOK, P. G.
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

COOK, S. C.
Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

COOLEY, M. E.
Artesian Pressures and Water Quality in Paleozoic Aquifers in the Ten Sleep Area of the Bighorn Basin, North-Central Wyoming.
W90-00206 2F

COONEY, J. J.
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

COOPER, P. F.
Demonstration and Evaluation of the Captor Process for Sewage Treatment.
W90-00254 5D

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

COOPER, R. C.
Turbidity and Color.
W90-00164 5G

CORBETT, E. S.
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

CORDERY, I.
Data for Assessment of Evapotranspiration and Soil Water.
W90-00121 2D

CORNABY, B. W.
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

CORNETT, R. J.
Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

CORTES, A.
Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

COTE, J. E.
Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

COTE, R.
Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

COTRUVO, J. A.
Drinking Water Standards and Risk Assessment.
W90-00922 5G

COWAN, E. A.
Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

COX, I. C. S.
Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

CRATHORNE, B.
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

CREELMAN, R. A.
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

CRESPO-RUIZ, M.
Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

CRESSER, M. S.
Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

CRILL, P. M.
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

CROWTHER, J.
Groundwater Chemistry and Cation Budgets of Tropical Karst Outcrops, Peninsular Malaysia: I. Calcium and Magnesium.
W90-00362 2K

CULLEN, P.
Social Choice, Risk and Determination in Water Quality Management.
W90-00695 6A

CUNNINGHAM, H. W.
Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

CURTIS, A. A.
REMISS: Research Management Information System.
W90-00129 10D

CURTIS, B.
Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

D'ANGLEJAN, B.
Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

D'ELIA, C. F.
Analytical Chemistry for Environmental Sciences.
W90-00542 5A

D'HULST, D.
Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

DA ROZA, G. D.
Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

DALE, J.
Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

DALEZIOS, N. R.
Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

DANIEL, D. E.
Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

DANIEL, P.
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

DANIELS, J. I.
Algae and Associated Aquatic Bacteria.
W90-00172 5G

Chloride.
W90-00166 5G

Research Recommendations.
W90-00173 5G

Total Dissolved Solids.
W90-00165 5G

DANIELS, S. A.
Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

DANIELSON, R. E.
Turbidity and Color.
W90-00164 5G

DARNERUD, P. O.
Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

DASCH, J. M.
Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

DAUBE, B.
Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

DAUVIN, J.
Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

DAVE, G.
Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

DAVID, A. W.
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

DAVIDSON, J. M.
Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

DAVIES, I. M.
Effects of Tributyltin on Dogwhelks (Nucella lapillus) from Scottish Coastal Waters.
W90-00635 5C

DAVIES, P. W.
Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

DAVIES, R. W.
Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

DAVIES, T. D.
Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

DAVIES, T. R. H.
Modification of Bedload Transport Capacity in Braided Rivers (Note).
W90-00936 2J

DAVIS, J. A.
Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

DAVIS, J. E.
Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

DAVIS, O. K.
Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

DAVIS, R. E.
Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

DAVIS, S. N.
Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

DE BORGER, R.
Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

DE JONG, A.
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

DE JONG, E.
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

DE KOCK, A. C.
Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

DE LA NOUE, J.
Biotreatment of Anaerobically Digested Swine Manure with Microalgae.
W90-00534 5D

Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

DE LAPPE, B. W.
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

DE LEEUW, F. A.
Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

DE MARSILY, G.
Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

DE MEIJER, R. J.
Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

DE OUDE, N. T.
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

DE SANTIS, J.
Vacuum Operation for Overloaded Anaerobic Treatment Systems.
W90-00754 5D

DE SILVA SAMARASINGHE, J. R.
Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

DEAN-ROSS, D.
Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

DEANGELIS, D. L.
Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

DEARTH, G. D.
Diversion Project Alleviates Saltwater Intrusion.
W90-00798 5G

DEBIKUNA, B. G.
Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

DEBUSK, T. A.
Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

DECEMBRINI, F.
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

DELAUNE, R. D.
Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

DELLEUR, J. W.
Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

DELVILLE, A.
Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

DEMMEL, J.
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

DENG, B.
Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

DENIKE, G.
Cyanide.
W90-00170 5G

DENNISON, R. A.
Engineering Approach to Waterline Thrust Restraint.
W90-00795 8A

DENTEL, S. K.
Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

DERMITZAKIS, M. D.
Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

DESAI, M. N.
Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

DESHMUKH, L.
Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

DESSERY, S.
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

DETAR, W. R.
Infiltration Function from Furrow Stream Advance.
W90-00894 3F

DEUTSCHMAN, M. R.
Atmospheric Deposition; North Dakota's Experience.
W90-00070 5A

DEVEREL, S. J.
Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

DEVI, V. U.
Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

DEVILLERS, J.
Acute Toxicity of Nitrophenols to Daphnia magna (Toxicite Aigue des Nitrophenols vis-a-vis de Daphnia magna).
W90-00672 5C

DEWALLE, D. R.
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

DHANARAJ, P. S.
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

DHARMVANIJ, S.
Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

DHAWAN, K. C.
Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

DI SILVIO, G.
Validity and Limitations of Different Transport Models with Particular Reference to Sediment Transport.
W90-00011 2J

DIAMOND, D. W.
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

DIAMOND, M.
Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

DIAMOND, S. A.
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

DIAPOULIS, A. C.
Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

DIAZ-CANEJA, N.
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

DIBB, J. E.
Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Berylllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

DICKERSON, D. R.
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

DIECKMANN, G. S.
Seasonal Variation in Uptake and Retention of Cadmium in the Seaweed Zostera marina L. from the Kiel Fjord (Western Baltic Sea) (Jahresgang, Aufnahme und Verbleib von Cadmium im Seegras Zostera Marina L. aus der Kieler Forde (Westliche Ostsee)).
W90-00260 5B

DIETRICH, W. E.
Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

DILLEY, R. S.
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

DISRUD, L.
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

DIXIT, A. S.
Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

DIXIT, S. S.
Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

DIXON, D. G.
Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

DIXON, P. M.
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

DOANE, T. R.
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

DOBBS, A. J.
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

DOBRYNIN, V. I.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

DODGE, R. A.
Overtopping Flow on Low Embankment Dams--Summary Report of Model Tests.
W90-00124 8B

DODHIWALA, N. S.
Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

DODSON, J. J.
Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

DOLD, P. L.
Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

DONG, L.
Study on Heavy Metal Partitioning in Sediments from Poyang Lake in China.
W90-00708 5B

DONIGIAN, A. S.
Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

DONKER, A. W.
Expectations for Water Level Deviations at the Delta Works: Zlerikzee (Netherlands), November 1981-February 1986 (Verwachtingen voor Water-Standsafwijkingen Deltawerken: Zierikzee November 1981-Februari 1986).
W90-00185 2L

DORTCH, M. S.
Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

DORTEN, W. S.
Heavy Metal Concentrations in the Mediterranean Estuarine Regions of the Rhone, Ebro, Po, and Arno Rivers (Ermittlung der Aktuellen Schwermetallbelastungen in den Mittelmeeraestuarien von Rhone, Ebro, Po und Arno).
W90-00273 5B

DOUABUL, A.
Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

DOUBEN, P. E. T.
Lead and Cadmium in Stone Loach (Noemacheilus barbatulus L.) from Three Rivers in Derbyshire.
W90-00684 5B

DOYLE, R.
Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

DRAKE, B. G.
Photosynthesis of Salt Marsh Species.
W90-00605 2H

DRESLER, P. V.
Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

DRISCOLL, C. T.
Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

DUBREUIL, B.
Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

DUDAS, M. F.
Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

DUFFY, P. D.
Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

DUNLAP, L. E.
Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

DUNNE, T.
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

DVORKIN, L. I.
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

DYSON, J. S.
Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

EAGLE, L. M.
Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

EARLEY, W. L.
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

EBDON, L.
Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

EBERT, D. J.
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

EDWARD, D. H. D.
Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

EDWARDS, K.
Assessment of Rainfall Erosion Hazard.
W90-00113 2J

EDWARDSON, S.
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

EHLINGER, F.
Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

EHRHARDT, M.
Dissolved Petroleum Residues and Alkylbenzene Photo-Oxidation Products in the Upper Arabian Gulf.
W90-00694 5B

EHRLICH, G. G.
Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

EICEMAN, G. A.
Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

EIGHMY, T. T.
Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

EKAMA, G. A.
Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

EL-ASSY, N. B.
Microdetermination of Trace Cobalt in Water by Direct Polyurethane from Thin-Layer Spectrophotometry.
W90-00294 5A

EL-DIDY, S. M. A.
Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

EL DIN, H. E.
Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

EL-GOHARY, F. A.
Wastewater Management in the Automobile Industry.
W90-00769 5D

ELBERT, W.
Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

ELDER, J. F.
Contamination, Bioaccumulation, and Ecological Effects of Creosote-Derived Compounds in the Nearshore Estuarine Environment of Pensacola Bay, Florida.
W90-00027 5B

ELEFTHERIADIS, I.
Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

ELLIOTT, D. C.
Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

ELLIS, K. V.
Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

ELZENGA, J. T. M.
Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

EMERSON, K. D.
In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

ENG, C. T.
Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

ENMING, W.
Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

EREN, J.
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

ERGASHEV, A. E.
Central Asian Irrigation Canals and some Aspects of their Algal Flora.
W90-00408 2H

ERICKSON, B. M.
Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

ERIKSSON, J. E.
Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

ERISMAN, J.
Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

ERNST, W.
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

ERSHOW, A. G.
Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources.
W90-00097 6D

ESHELMAN, R. H.
Spinning Air Blasts Operating Costs.
W90-00668 5D

ESTELA, J. M.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

ETNEIR, E. L.
Role of Health-Based Criteria Development in USATHAMA's Installation Restoration Program.
W90-00243 5C

EVANS, K.
Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

EVANS, R. D.
Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

EWING, C.
Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

EYCHANER, J. H.
Geohydrologic Setting of the Miami Wash-Pinal Creek Acidic Ground-Water Study Area near Globe, Arizona.
W90-00042 2F

FAIRBURN, B. A.
New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

FALCONER, R. A.
Numerical Modelling of the Vertical Tidal Current and Salinity Structure in a Deep Water Scottish Loch.
W90-00519 2L

FALLON, R. D.
Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

FALLOWFIELD, H. J.
Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

FANG, Z. X.
Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

FANNER, P.
Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

FARAG, B.
Semiquantitative and Quantitative Determination of Trace Amount of Phosphate Ion in Water Using Polyurethane Foam Thin-Layer Colorimetry.
W90-00298 5A

FARKE, H.
Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

FARMER, A. H.
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

FAROOQ, S.
Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

FARVOLDEN, R. N.
Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

FASTENAU, F. A.
Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

FATTORELLI, S.
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

FAULKNER, S. P.
Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

FAUP, G. M.
Influence of Seeding Conditions on Initial Biofilm Development During the Start-up of Anaerobic Fluidized Bed Reactors.
W90-00760 5D

FDZ-POLANCO, F.
Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

FEDERLE, T. W.
Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

FEDORAK, P. M.
Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

FEIJTEL, T. C.
Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

FELTZ, H. R.
Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

FENSTERMACHER, J. M.
Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

FERAL, A.
Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

FERNANDES, X. A.
Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

FERRARI, G. M.
Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

FERRARI, R. L.
1986 Lake Powell Survey.
W90-00126 2J

FERRARIO, P.
Behavior of Cd, Pb, and Cu in the Marine Deltaic Area of the Po River (North Adriatic Sea).
W90-00815 5B

FERRETTI, O.
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

FICKEN, J. H.
Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

FICKLIN, W. H.
Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

FIEBIG, D. M.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

FIELDING, M.
Aqueous Chlorination of Permethrin.
W90-00914 5F

FILER, T. H.
Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

FILIP, Z.
Humic Substances Isolated from Spartina alterniflora (Loisel.) Following Long-Term Decomposition in Sea Water.
W90-00559 2L

FILIPEK, L. H.
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

FILIPEK, S. P.
Response of Fish Communities to Habitat Alteration in a Small Ozark Stream.
W90-00282 4C

FILON, I. I.
Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

FINNEY, H. J.
Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

FLATAU, G. N.
Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

FLEMING, G.
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

FLEMING, P. M.
Minimum Data Sets: Hydrological Applications.
W90-00103 3F

FLEMMING, C. A.
Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

FLEUREN-KEMILA, A. K.
Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

FLIERMANS, C. B.
Microbial Life in the Terrestrial Subsurface of Southeastern Coastal Plain Sediments.
W90-00464 2G

FLINN, J. C.
Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

FLODERUS, S.
Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

FLORENCE, T. M.
Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

FOCARDI, S.
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

FOERST, C.
Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

FOERSTNER, U.
Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

FOGEL, M. L.
Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

FONTAINE, R. A.
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

FORD, T. E.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

FORJAN, C.
Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

FORSBERG, C.
Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

FORSTER, C. F.
Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

FORTEZA, R.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

FORWARD, R. B.
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

FOSSI, C.
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

FOSTER, G. R.
Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

FOSTER, S.
Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

FOX, A. M.
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

FOX, I.
Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

FRANKE, O. L.
Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

FRANKENBERGER, W. T.
In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

FRANKS, B. J.
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

FRANZI, D. A.
Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

Surficial and Subsurface Distribution of Aquifer Sediments at the Bemidji, Minnesota, Research Site.
W90-00033 2F

FREDERIKSEN, H. D.
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

FRENCH, R. H.
Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

FRENCH, R. J.
Simple Models for Use by Advisory Officers to Define Crop Strategies and to Predict Farm Yields.
W90-00115 3F

FRICKER, H.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

FRIE, R. F.
Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

FRIEDMAN, A. A.
Vacuum Operation for Overloaded Anaerobic Treatment Systems.
W90-00754 5D

FRIEGE, H.
Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

FRILIGOS, N.
Nutrients Status in a Eutrophic Mediterranean Lagoon.
W90-00671 2L

FRINK, D. L.
Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

FRISK, T.
Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

FRITSCH, A. F.
Relative Contributions of Food and Water in the Accumulation of Co-60 by a Freshwater Fish.
W90-00413 5B

FROEHLICH, D. C.
Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

FRYE, C. L.
Piscine Bioconcentration Characteristics of Cyclic and Linear Oligomeric Permethylsiloxanes.
W90-00553 5B

FUJII, K.
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

FUKUNAGA, I.
Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

FUKUSHIMA, T.
Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

FUKUSHIMIMA, M.
Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

FULLER, C. C.
Role of Complexation and Adsorption Processes in Toxic Metal Transport.
W90-00062 5B

FULLER, R. D.
Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

FURUMAI, H.
Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

FUSILLO, T. V.
Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

GABB, D. M. D.
Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

GAGEN, C. J.
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

GAGGINO, G. F.
Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

GAL'PERIN, M. D.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

GALASSI, S.
Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

GALLANTHINE, S. K.
Relation of Salinity and Selenium in Shallow Groundwater to Hydrologic and Geochemical Processes, Western San Joaquin Valley, California.
W90-00582 2F

GAMBRELL, R. P.
Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

GANCHIKOV, V. G.
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

GANDRASS, J.
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

GARABEDIAN, S. P.
Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

GARBEDIAN, S. P.
Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

GARBRECHT, G.
Hydraulic Calculations for Flow Under Dikes on Consolidated Beds (Untergrundhydraulische Berechnungen an Flussdeichen auf Bindigen Deckschichten).
W90-00257 2F

GARDEA-TORRESDEY, J. L.
Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

GARNER, S. B.
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

GARRIGAN, P. A.
Directions in Water Conservation and Management in Massachusetts.
W90-00651 3D

GATZ, D. F.
Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

GAUTHIER, M. J.
Uptake of Cadmium by Marine Bacteria.
W90-00289 5C

GAVASKAR, A. R.
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

GEIGER, W. F.
Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

GENOT, J.
Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

GEORGE, L.
Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

GHANI, M. A.
Gravity Irrigation Management in Bangladesh.
W90-00887 3F

GHAZALI, A. W.
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

GIBIAN, G. P.
Acid Deposition Research and Policy.
W90-00069 5B

GIBS, J.
Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

GIESKES, J.
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

GIESY, J. P.
Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

GIGER, W.
Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

GILBERT, J. J.
Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

GILL, M. A.
Response of Muskingum Equation to Step Input.
W90-00896 2E

GILLIAM, J. W.
Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

GILLOT, A.
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

GIORGINI, A.
Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

GIPPEL, C. J.
Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

GIUFFRE, G.
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

GLANCY, P. A.
Streamflow, Sediment Transport, and Nutrient Transport at Incline Village, Lake Tahoe, Nevada, 1970-73.
W90-00219 2E

GLAZE, W. H.
Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

GODSY, E. M.
Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

GOERLITZ, D. F.
Determination of the Rates of Anaerobic Degradation of the Water-Soluble Fraction of Creosote.
W90-00026 5B

Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

Reexamination of the Occurrence and Distribution of Creosote Compounds in Ground Water.
W90-00025 5B

GOERRLITZ, D. F.
Effects of Pentachlorophenol on the Methanogenic Fermentation of Phenol.
W90-00061 5C

GOFORTH, G. F.
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

GOLDSMITH, C. D.
Biokinetic Constants of a Mixed Microbial Culture with Model Diesel Fuel.
W90-00463 5G

GOLDSTEIN, N. E.
Ground Conductivity Measurements Adjacent to the Kesterson Ponds 1, 2, and 5.
W90-00139 2G

GOLDSTEIN, R. A.
Effectiveness of Liming to Mitigate Lake-Watershed Acidification.
W90-00065 5G

GOLLADAY, S. W.
Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

GOLLEY, F. B.
Nutrient Input and Output of an Irrigated Agroecosystem in an Arid Mediterranean Landscape.
W90-00432 3F

GOMEZ-HERNANDEZ, J. J.
Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

GOMEZ, M.
Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

GOMEZ-PARRA, A.
Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

GONZALEZ, E. A.
Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

GONZALEZ-FUENTES, E. A.
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

GOOSSENS, R.
Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

GORDON, M. E.
Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

GORELICK, S. M.
Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

Influence of Spatial Variability of Aquifer and Recharge Properties in Determining Effective Parameter Values.
W90-00232 2F

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

GORHAM, E.
Influence of Lake Surface Area and Depth upon Thermal Stratification and the Depth of the Summer Thermocline.
W90-00843 2H

GORMAN, T.
Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

GOTO, K.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

GOURLAY, M. R.
Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

GOYAL, M. R.
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

GRABBE, R. R.
Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

GRABOW, W. O. K.
Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

GRADY, C. P. L.
Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

GRANBOULAN, J.
Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

GRANDI, M.
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

GRASSIA, A.
Algorithm for the Interpretation of Groundwater Field Experiments.
W90-00934 2F

Depth Distribution of an Applied Tracer in Groundwater Field Experiments.
W90-00933 2F

GRAU, P.
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

GRAY, N. F.
BOD Incubators and Temperature Variability.
W90-00488 5A

Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

GRAY, S.
Florida Acid Deposition Research Program.
W90-00068 5C

GRAYBEAL, K. D.
Cutoff Wall Construction to Upgrade Mud Mountain Dam.
W90-00155 8E

GREBEN, H. A.
Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

GREEN, C. H.
Flooding and the Quantification of 'Intangibles'.
W90-00925 6A

GREENBERG, R. J.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

GREENSTEIN, D. J.
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

GREENWALD, R. M.
Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

GREENWOOD-SMITH, R.
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

GREGOR, D.
Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

GRIEVE, A.M.
Water Use Efficiency, Nutrient Uptake and Productivity of Micro-Irrigated Citrus.
W90-00290 3F

GRIFFIN, R. A.
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

GRIFFIN, T. M.
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

GRIFFIS, W. L.
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

GRIMALT, J. O.
Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

GRIMM, J. W.
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

GROFCSIK, A.
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

GROVE, D. B.
Modeling Sorptive Processes in Laboratory Columns.
W90-00058 2K

GRUNTFEST, E.
Status Report on Flood Warning Systems in the United States.
W90-00452 6F

GUANGHAN, L.
Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

GUARIN, F. Y.
Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

GUENTHER, P. M.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

GUJER, W.
Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

GULLIVER, J. S.
Air-Water Gas Transfer in Open Channels.
W90-00944 2E

GUNNEBERG, F.
Heat and Moisture Losses of Heated Rivers (Waerme und Feuchteabgabe Aufgeheizter Fluesse).
W90-00182 5B

GUNNISON, D.
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

GUNTEN, H. R.
Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

GUNTING, H.
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

GUPTA, R. K.
Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

GUTIERREZ, I.
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

HABEGGER, L. J.
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

HACKNEY, C. T.
Potential Role of Roots and Rhizomes in Structuring Salt-Marsh Benthic Communities.
W90-00280 2L

HAHN, J.
Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

HAIMI, J.
Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

HAJ-HUSSEIN, A. T.
Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

HAKANSON, L.
Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

HAKONSON, T. E.
Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

HAKTANIR, T.
Storage-Yield Relationships for Reservoirs by a Sequential-Operation Algorithm and Comparisons with Gould's Probability Matrix Method.
W90-00576 2H

HALE, L. G.
Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

HALES, T. A.
Floods of November 1978 to March 1979 in Arizona and West-Central New Mexico.
W90-00193 2E

HALEY, J.
Aqueous Chlorination of Permethrin.
W90-00914 5F

HALL, R. L.
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

HALLEUX, R.
Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

HALLEY, B. A.
Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

HALUSCHAK, P. W.
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

HALVERSON, M. J.
Air-Water Gas Transfer in Open Channels.
W90-00944 2E

HAMILTON, P. J.
Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

HAMMER, G. L.
Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

HAMMONS, M. I.
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

HANSON, J. E.
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

HANSON, M. E.
Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

HAO, O. J.
Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

HARADA, H.
Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

HARMS, T. F.
Problems Associated with the Analysis of Plant Samples in the Tar Creek Study.
W90-00041 5A

HARRIS, H. C.
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

HARRISON, W.
Influence of the 1982-83 Drought on River Flows in Hawke's Bay.
W90-00932 2E

HARRISS, R. C.
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

HART, B. T.
Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

HART, W. E.
Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

HARVEY, H. H.
Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

HARVEY, H. R.
Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

HARVEY, R. W.
Bacterial Distribution and Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00031 5B

HASFURTHER, V. R.
Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

HASHINAGA, T.
Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

HATA, N.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

HATCH, P. C.
Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

HAUX, C.
Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

HAVIS, R. N.
Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

HAYASHI, Y.
Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

HAYS, S. G.
Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

HAYTER, E. J.
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

HAZEN, T. C.
Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

HE, L.
Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

HEAGLE, A. S.
Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

HEALY, R. W.
Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

HEARN, A. B.
Use of Climatic Data with a Crop Water Balance Model and Crop and Pest Response Models in Northern New South Wales.
W90-00118 3F

HECK, W. W.
Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

HECKMAN, K.
Cyanide.
W90-00170 5G

HEDLUND, J. D.
Wellton-Mohawk Farmers Deliver Water Conservation.
W90-00325 3F

HEGSTROM, L. J .
Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

HEIJBOER, R. J.
Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

HEIL, D. M.
Water Treatment Sludge Influence on the Growth of Sorghum-Sudangrass.
W90-00566 5E

HEINL, M.
Groundwater Model of the Nubian Aquifer System.
W90-00940 2F

HEIT, M.
Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

HEITHMAR, E. M.
Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

HEITKAMP, M. A.
Polycyclic Aromatic Hydrocarbon Degradation by a Mycobacterium sp. in Microcosms Containing Sediment and Water from a Pristine Ecosystem.
W90-00393 5B

HELINSKY, B. M.
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

HELIOTIS, F. D.
Water Storage Capacity of Wetland Used for Wastewater Treatment.
W90-00663 5D

HELLSTEN, S.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

HENDERSON, B. A.
Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

Yellow Perch (Perca flavescens) Growth and Mortality Rates in Lake St. Clair and the Three Basins of Lake Erie, 1963-86.
W90-00849 2H

HENNING, S. A.
Potential Demand for Supplemental Irrigation In the Lower Mississippi Valley.
W90-00332 3F

HENRIKSEN, A.
'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

HERAT, K. S. M.
Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

HERMANOWICZ, S. W.
Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

HERNDL, G. J.
Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

HERRERO LATORRE, C.
Rubidium Determination in Mineral and Thermal Waters by Atomic-Absorption Spectrometry.
W90-00296 7B

HERSFELD, D.
Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

HESS, B. C.
Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

HESS, K. M.
Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

HEURTEAUX, P.
Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

HEUSER, H. H.
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

HEYMANN, J. B.
Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

HIASA, M.
Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

HIGGINS, M. L.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

HILL, C. M.
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

HILL, E.
Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

HILL, R. W.
Gravity Irrigation Management in Bangladesh.
W90-00887 3F

LP Operation Model for On-demand Canal Systems.
W90-00891 3F

HILL, S.
Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

HILLMAN, D. C.
Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

HINCKLEY, D. A.
Analysis of Pesticides in Seawater after Enrichment onto C8 Bonded-Phase Cartridges.
W90-00689 5A

HINEDI, Z. R.
Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

HIRAI, E.
Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

HISCOCK, K. M.
Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

HO, C. C.
Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

HOBSON, J. A.
Sewage Treatment by Reed Bed Systems.
W90-00929 5D

HOCHREITER, J. J.
Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

HODGKISS, S. S.
Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

HOEHN, E.
Radon in Groundwater: A Tool to Assess Infiltration from Surface Water to Aquifers.
W90-00945 2F

HOFFMAN, H.-E.
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

HOFFMAN, R. J.
Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

HOFFMANN, M. R.
Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

HOKE, R. A.
Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

HOLLADAY, S. K.
Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

HOLLETT, K. J.
Geohydrology and Water Resources of the Papago Farms-Great Plain Area, Papago Indian Reservation, Arizona, and the Upper Rio Sonoyta Area, Sonora, Mexico.
W90-00198 2F

HOLST, K. A,
Modelling the Irrigaiton Need.
W90-00957 3F

HOLT, M. S.
Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

HOODA, P. S.
Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

HOPKINS, E.
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

HOPPLE, J. A.
Geochemistry of a Shallow Aquifer Contaminated with Creosote Products.
W90-00024 5B

HORDIJK, C. A.
Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

HORNER, R. R.
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

HORTON, R.
Canopy Shading Effects on Soil Heat and Water Flow.
W90-00378 2G

HOSTETTLER, F. D.
Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

HOUGHTON, R. L.
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

HOUSE, W. A.
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

HOWINGTON, S. E.
Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

HREN, J.
Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

HRUDEY, S. E.
Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

HSIEH, D.
Lindane.
W90-00171 5G

HSIEH, D. P. H.
Arsenic.
W90-00169 5G

Cyanide.
W90-00170 5G

Magnesium.
W90-00167 5G

Sulfate.
W90-00168 5G

HUBBARD, R. K.
Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

HUBBELL, D. W.
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

HUBER, C.
Status Report on Flood Warning Systems in the United States.
W90-00452 6F

HUEBNER, P. M.
Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

HUGGINS, L. F.
Field Data Acquisition Systems.
W90-00021 7B

HUGHES, M. W.
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

HUHTA, V.
Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

HULLAR, M.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

HULT, M. F.
Distribution of Gases and Hydrocarbon Vapors in the Unsaturated Zone.
W90-00036 5B

Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

HUNGSPREUGS, M.
Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

HUNN, J. B.
Field Assessment of the Effects of Contaminants on Fishes.
W90-00083 5C

HUTCHINSON, M. F.
New Objective Method for Spatial Interpolation of Meteorological Variables from Irregular Networks Applied to the Estimation of Monthly Mean Solar Radiation, Temperature, Precipitation and Windrun.
W90-00108 7C

HUTIRA, J.
Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

HUTTON, J. M.
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

HUTTUNEN, P.
Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

HUZZEY, L. M.
Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

IMBRIGIOTTA, T. E.
Evaluation of Four Field-Determined Characteristics Used as Water-Quality Indicators during Aquifer Sampling for Purgeable Organic Compounds.
W90-00051 5A

Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

INGRAM, R. G.
Abundance of Larval Rainbow Smelt (Osmerus mordax) in Relation to the Maximum Turbidity Zone and Associated Macroplanktonic Fauna of the Middle St. Lawrence Estuary.
W90-00279 2L

INMAN, E. J.
Simulation of Flood Hydrographs For Georgia Streams.
W90-00221 2E

INOUE, Z.
Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

IRVINE, R. L.
Oxidation of Phenolic Pollutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

ISNARD, P.
Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

ISRAELI, I.
Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

IVES, K. J.
Filtration Studied with Endoscopes.
W90-00419 5F

IWAMOTO, H.
Improvements in Soil Absorption Trench Design.
W90-00665 5D

IZRAEL, Y. A.
Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

IZSAKI, Z.
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

JACKS, G.
Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
W90-00578 2K

JACKSON, B. R.
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

JACKSON, I. J.
Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

JACKSON, W. L.
Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

JACOB, T. A.
Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

JACOBS, H. M.
Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

JAIN, S. K.
Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

JAMES, R. W.
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

JARDINE, P. M.
Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

JARDINS, R.
Model-Based Approach to the Use of Climatic Data for Assessing Probabilities of Rainday and Dryday Sequences.
W90-00112 2B

JARMAN, W. M.
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

JARRELL, W. M.
Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

JARSKI, R. S.
Get Control of Your Activated Sludge Process.
W90-00667 5D

JARVIS, N. J.
Simple Empirical Model of Root Water Uptake.
W90-00355 2I

JEAN, H. M.
Get Control of Your Activated Sludge Process.
W90-00667 5D

JEFFERS, P. M.
Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

JELTES, R.
Information Requirements of Integrated Environmental Policy Experiences in the Netherlands.
W90-00455 7A

JENKINS, A.
Storm Period Hydrochemical Response in an Unforested Scottish Catchment.
W90-00937 5B

JENKINS, C. J.
Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

JENKINS, D.
Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

JENSEN, K. M.
Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

JENSEN, M. E.
Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

JEROME, J. J.
Determination of Irradiation and Primary Production Using a Time-Dependent Attenuation Coefficient.
W90-00850 2H

JESSUP, R. E.
Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

JHA, N. K.
Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

JOHANNESSON, H.
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

JOHNSON, B. D.
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

JOHNSON, I.
Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

JOHNSON, J. D.
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

JOHNSON, L. H.
Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

JOHNSON, M. G.
Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

JOHNSON, N. M.
Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

JOLLEY, R. L.
Interim: Selected Chemical Research Reported Between Conferences Five and Six.
W90-00092 5D

Trace Substances Present as Chlorination By-Products in Drinking and Process Waters.
W90-00242 5F

JONES, M. B.
Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

JONES, S.
Sewage Treatment by Reed Bed Systems.
W90-00929 5D

JONKER, F. A.
Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

JORDAN, P. R.
Magnitude and Frequency of High Flows of Unregulated Streams in Kansas.
W90-00204 2E

JORDAO, C. P.
Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

JORGENSEN, S. E.
Developments in Ecological Modelling.
W90-00003 7C

JOSBERGER, E. G.
Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

JOSHI, S. R.
Estimation of Mixing Rates in Western Lake Ontario Sediments by Finite Element Analysis of 210Pb Profiles.
W90-00447 2J

JUEMIN, C.
Effects of Some Chemical Factors on the Larvae and Adults of Scapharca broughtonii (Schrenek), (in Chinese).
W90-00374 5C

JUHNKE, I.
Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

JURASCHEK, M.
Transport and Sedimentation of Suspended Matter in Obstructed and Unobstructed Running Waters, (Transport-und Sedimentationsverhalten

von Suspensa in Ungestauten und Gestauten Fliessgewaessern).
W90-00259 2J

KAFRITSAS, I. A.
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

KAJ, L.
Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

KALINOVSKII, A. V.
Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

KALKANI, E. C.
Polynomial Regression to Forecast Earth Dam Piezometer Levels.
W90-00880 8C

KALMA, J. D.
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

KALMAN, J.
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

KAMIL, A. Q. A.
Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

KAMMER, J. A.
Screening for Volatile Organic Compounds in Ground Water by Gas Chromatography with Photoionization and Hall Detectors.
W90-00049 5A

KANNAN, N.
Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

KAPINOS, F. P.
Hydrologic Unit Maps.
W90-00207 7C

KARIM, M. I. A.
Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

KARIYAWASAM, C.
Economic Impact of Micro Catchment Development.
W90-00882 4A

KARYAKIN, A. V.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

KASAHARA, I.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

KASAI, Y.
Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

KASAN, H. C.
Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

KAURI, T.
Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

KAWAKAMI, K.
Continuous Flow Method for Determination of Total Trihalomethanes in Drinking Water with Membrane-Separation.
W90-00831 5A

KAWAMOTO,
Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

KAWASE, M.
Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

KEANE, R. E.
Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

KEEFER, R. F.
Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

KELLY, J. M.
Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

KELLY-REIF, J.
Lindane.
W90-00171 5G

KELLY, W. E.
Relationships Between the Unsaturated Electric and Saturated Hydraulic Properties of Soils.
W90-00581 2G

KEMPE, M.
Overview of the MWRA Water Conservation Program.
W90-00652 3D

KENNEDY, J. F.
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

KENNEDY, K. J.
Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

KENTANG, L.
Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

KERFOOT, W. C.
Scale-Dependent Dynamics: Zooplankton and the Stability of Freshwater Food Webs.
W90-00624 2H

KERMAN, B. R.
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

KESEL, R. H.
Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A.
W90-00446 6G

KEUKEN, M. P.
Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

KFIR, R.
Detection of Endotoxins in Reclaimed and Conventionally Treated Drinking Water.
W90-00830 5A

KHALAF, S. H.
Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

KHALEEL, R.
Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

KHALIL, M.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

KHAN, A.
Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

KHAN, G. J.
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

KHAN, H. A.
Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

KHARAT, R. B.
Separation of Metal Ions in Tube Well Water Samples by Thin Layer Partition Chromatography.
W90-00864 5A

KHARCHAF, I.
Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

KHATTAK, R. A.
Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

KHOE, G. H.
Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

KIDD, R. E.
Application of the Precipitation-Runoff Model in the Warrior Coal Field, Alabama.
W90-00214 2A

KILE, D. E.
Water Solubility Enhancements of DDT and Trichlorobenzene by Some Surfactants Below and Above the Critical Micelle Concentration.
W90-00536 5B

KILLGORE, K. J.
Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

KIM, B. R.
Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

KIMBROUGH, D. E.
Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

KIMMEL, W. G.
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

KINGERY, K. M.
Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

KINGSBURY, C. M.
Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

KINNERSLEY, D.
Water Supply: Quality, Economics and Planning for the Future.
W90-00650 6A

KIRBY-SMITH, W.
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

KIRILLOV, A. F.
Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

KIRK, P. W. W.
Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

KIRSCH, E. J.
Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

KISH, G. R.
Field Comparison of Ground-Water Sampling Devices for Recovery of Purgeable Organic Compounds.
W90-00047 7B

KITAGAWA, M.
Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

KITANIDIS, P. K.
Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

KLINGMUELLER, O.
Dynamic Load Testing of Piles (Kynamische Tragfaehigkeitspruefungen bei Bohrpfaehlen).
W90-00262 8G

KNAPP, G. L.
Hydrologic Unit Maps.
W90-00207 7C

KNAUTH, H. D.
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

KNISEL, W. G.
Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

KNOBEL, L. L.
Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

KNOTT, J. F.
Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

KOBAYASHI, T.
Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

KOBUS, K.
Modelling of Large-Scale Heat and Contaminant Transport in Groundwater: Report of Activities 1986/87 (Modellerung des Grossraeumigen Waermetransports und Schadstofftransports im Grundwasser: Taetigkeitsbericht 1986/87).
W90-00269 2F

KOERTING-WALKER, C.
Effect of Bacteria and Bioturbation by Clymenella torquata on Oil Removal from Sediment.
W90-00819 5B

KOFFSKEY, W. E.
Granular Activated Carbon Adsorption with On-Site Infrared Furnace Reactivation.
W90-00248 5F

KOGA, M.
Ozonation Byproducts: Improvement of an Aqueous-Phase Derivatization Method for the Detection of Formaldehyde and Other Carbonyl Compounds Formed by the Ozonation of Drinking Water.
W90-00537 5F

KOH, W. K.
Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

KOJIMA, M.
Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

KOMPTER, M. G.
Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

KONDAKIS, X.G.
Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

KONDO, T.
Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

KONONEN, D. W.
PCBs and DDT in Saginaw Bay White Suckers.
W90-00485 5B

KORTE, F.
Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

KOSTELNIK, K. M.
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

KOUSSIS, A. D.
Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

KOUSSOURIS, T. S.
Assessing the Trophic Status of Lake Mikri Prespa, Greece.
W90-00599 2H

KOVACS, L.
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

KOVALEVSKY, V. S.
Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

KOWALIK, P. J.
Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

KRAPAC, I. G.
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

KRIMMEL, R. M.
Glaciers and Glaciology of Alaska.
W90-00077 2C

KRISHNAMURTHY, K.
Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

KRONE, R. B.
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

KRONER, S.
Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

KRONICK, A. T.
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

KRZEMIENIEWSKI, M.
Electrobiological Wastewater Treatment.
W90-00529 5D

KUCERA, J.
Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

KUDO, A.
Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

KUEHL, D. W.
Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

KUHN, A. L.
Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

KUHN, E. P.
Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

KUHN, R.
Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

KUHNMUENCH, S.
Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

KUMADA, H.
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

KUMAR, A.
Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

KUMAR, S.
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

KUNZ, P.
Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

KURATA, A.
Effect of Low Water Levels on the Water Quality of Lake Biwa.
W90-00698 2H

KUUSELA, K.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

KVENVOLDEN, K. A.
Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

LAARA, E.
Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

LACEY, R. F.
Water Recreation and Risk.
W90-00923 4C

LAIR, N.
Seasonal Succession of Planktonic Events in Lake Aydat, France: A Comparison with the PEG Model.
W90-00597 2H

LAL, R.
Bioconcentration and Metabolism of Aldrin and Phorate by the Blue-green Algae Anabaena (ARM 310) and Aulosira fertilissima (ARM 68).
W90-00433 5B

LAL, S.
Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

LALAZAROV, B. K.
Rubber Watertight Facings from Tire Production Wastes.
W90-00790 8G

LAMBERT, S.
Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

LANCELOT, C.
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

LANDGRAF, J.
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

LANDINE, R. C.
Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

LANE, L. J.
Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

LANGGUTH, H. R.
Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

LANIGAN, S. H.
Population Size and Status of the Razorback Sucker in the Great River Basin, Utah and Colorado.
W90-00617 8I

LANOCE, T.
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

LANTRIP, B. M.
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

LAPOINTE, B. E.
Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

LAPOINTE, L.
Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

LARREA, L.
Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

LARSON, M. J.
Age Verification of Walleyes from Lake of the Woods, Minnesota.
W90-00847 2H

LARSON, T. V.
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

LARSSON, A.
Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

LASALA, A. M.
Role of Earth-Science Criteria in the Selection of Hazardous-Waste Disposal Sites.
W90-00055 5E

LATCHAW, J. L.
Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

LATHROP, R. C.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

LAUGHLIN, G. P.
Regional Evaporation Project: Processing and Archiving of Field Data.
W90-00080 2D

LAUGHLIN, J. D.
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

LAULAINEN, N. S.
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

LAW, C. S.
Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

LAYTON, D. W.
Chloride.
W90-00166 5G

Cyanide.
W90-00170 5G

Research Recommendations.
W90-00173 5G

Total Dissolved Solids.
W90-00165 5G

LE GAL LA SALLE, Y.
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

LE MOIGNE, G. J. M.
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

LEBLANC, D. R.
Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

LECK, C.
Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

LECOMTE, P.
Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

LEDUC, R.
Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

LEE, C. K.
Removal of Copper From Solution Using Moss.
W90-00496 5D

LEE, C. M.
Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

LEE, D. R.
Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

LEE, J. K.
Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

LEE, R. W. K.
Characterization of Phosphorus in Sludge Extracts Using Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy.
W90-00568 5A

LEGRAND, H. E.
Innovative Hydrogeologic Setting for Disposal of Low-level Radioactive Wastes.
W90-00451 5E

LEISMANN, H. M.
Calculations of Dispersion Processes in Groundwater by the Method of Finite Elements (Berechnung von Ausbreitungsvorgaengen im Grundwasser mit der Methode der Finiten Elemente).
W90-00187 5B

LELAND, H. V.
Use of Detrended Correspondence Analysis to Identify Factors that Affect the Structure of Aquatic Communities.
W90-00057 7B

LEMA, J. M.
Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

LEMAIRE, J.
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

LENNON, G. W.
Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

LENNOZ-GRATIN, C.
Effect of Envelopes on Flow Pattern near Drain Pipe.
W90-00886 7B

LEONARD, R. A.
Selection and Application of Models for Non-point Source Pollution and Resource Conservation.
W90-00012 5B

LEONZIO, C.
Regulatory Detoxication Responses in Gobiidae Experimentally Exposed to PCBs.
W90-00682 5C

LEOTSINIDIS, M.
Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

LERCH, M.
Liquid Chromatography System for Measurement of Organic Acids in Precipitation.
W90-00857 5A

LERNER, D. N.
Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

LESTER, J. N.
Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

Degradation of Phenol, Selected Chlorophenols and Chlorophenoxy Herbicides During Anaerobic Sludge Digestion.
W90-00497 5D

Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

LEVENTER, H.
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

LEWENSTEIN, S. M.
Investigation of Archaic Subsistence and Settlement in the Harquahala Valley, Maricopa County, Arizona.
W90-00150 6G

LEWIS, J. A.
Application of the Gas Chromatographic/Flame Ionization Detector Analysis.
W90-00050 5A

LEWIS, T. E.
Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

LEWIS, W. J.
Impact of Plastic Materials on Iron Levels in Village Groundwater Supplies in Malawi.
W90-00930 2F

LEWIS, W. M.
Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

LIAO, P. H.
Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

LICHENG, Z.
Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

LICHTENSTEIGER, T.
Use of Sludge-Only Landfills as Historical Records of Persistent Organic Chemicals and Heavy Metals in Sewage Sludge.
W90-00915 5E

LICO, M. S.
Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

LIEHU, A.
Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

LIJKLEMA, L.
Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

LIKENS, G. E.
Acid Rain and its Effects on Sediments in Lakes and Streams.
W90-00722 5C

LILJESTRAND, H. J.
Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

LIMON, J. G.
Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

LIMONI, M.
Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

LIN, C. Y.
Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

LINACRE, E.
Estimating Climatic Data.
W90-00105 7C

LIND, O. T.
Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

LINDAHL, S.
Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

LINDGREN, R. J.
Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

LINDHOLM, T.
Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

LINDSTROM, J. E.
Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

LINKFIELD, T. G.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

LINTNER, S. F.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

LITTLE, C. E.
Charmed Life of a Lake Called Prairie Rose.
W90-00327 5G

Geology and Survival on the Snake River Plain.
W90-00335 5G

LLOYD, J. W.
Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

LO, K. V.
Anaerobic-Aerobic Biological Treatment of a Mixture of Cheese Whey and Dairy Manure.
W90-00527 5D

Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

LOAICIGA, H. A.
Optimization Approach for Groundwater Quality Monitoring Network Design.
W90-00943 7A

LOCK, M. A.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

LODENIUS, M.
Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

LOEBEL, H.
Experiences with Two Hot Wire Instruments for Measuring the Liquid Water Content in Clouds.
W90-00244 7B

LOGSDON, G. S.
Comparisons of Various Filtration Media.
W90-00238 5F

LONDONG, J.
Dimensions of Aerated Grit Chambers and Use as a Highly Loaded Activated Sludge Process.
W90-00747 5D

LONGABUCCO, P.
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

LONGSTRETH, D. J.
Photosynthesis and Photorespiration in Freshwater Emergent and Floating Plants.
W90-00610 2H

LOOMIS, J. B.
Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries.
W90-00333 4C

LOPEZ-AVILA, V.
Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

LORD, D. A.
Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

LOUW, R.
Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

LOW, K. S.
Removal of Copper From Solution Using Moss.
W90-00496 5D

LU, A. Y. H.
Environmental Impact of the Use of Ivermectin: Environmental Effects and Fate.
W90-00439 5C

LUCEY, W. P.
Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

LUEDIECKE, C.
Precipitation of Ferric Phosphate in Activated Sludge: a Chemical Model and Its Verification.
W90-00776 7C

LUGO, T.
Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

LUKLEMA, L.
Development and Application of a Model for Regional Water Quality Management.
W90-00835 5G

LUMBERS, J. P.
Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

LUND, B. O.
Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

LUND, L. J.
Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

LUOMA, S. N.
Can We Determine the Biological Availability of Sediment-bound Trace Elements.
W90-00726 5B

Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

LUTHY, R. G.
Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

LYKINS, B. W.
Point-of-Use/Point-of-Entry Systems for Removing VOCs from Drinking Water.
W90-00137 5F

LYNCH, J. A.
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

LYNGBY, J. E.
Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

LYON, D. K.
Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

LYONS, J.
Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

MABERLY, S. C.
Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

MACALADY, D. L.
Towards a Standard Method for the Measurement of Organic Carbon in Sediments.
W90-00861 7B

MACDONALD, S. M.
Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

MACINTYRE, D. F.
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

MACKAY, D.
Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

MACLEOD, D. A.
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

MADSEN, H. B.
Modelling the Irrigaiton Need.
W90-00957 3F

MADSEN, J. D.
Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

MADSEN, M.
Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

MAEDA, H.
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

MAHMOOD, T.
Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

MAHYAOUHI, M.
Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

MAIDMENT, D. R.
Design of Wastewater Storage Ponds at Land Treatment Sites. II: Equilibrium Storage Performance Functions.
W90-00655 5E

MAIER, G.
Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

MAIMO, J.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

MAJIMA, T.
Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

MAKAREWICZ, J. C.
Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

MAKKAR, N. S.
Butyltins in sediments From Boston Harbor, USA.
W90-00483 5B

MAKRIS, N.
Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

MALATI, M. A.
Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

MANCA, D.
Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

MANDRAK, N. E.
Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

MANGAL, J. L.
Salt Tolerance of Five Muskmelon Cultivars.
W90-00281 3F

MANGIN, A.
Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

MANI, P.
Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

MANNING, R. M.
Statistical Rain Attenuation Prediction Model with Application to the Advanced Communication Technology Satellite Project. I--Theoretical Development and Application to Yearly Predictions for Selected Cities in the United States.
W90-00094 2B

MANSOUR, A. R.
State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

MAOYU, Y.
Electrode system for Determination of Microbial Cell Populations in Polluted Water.
W90-00397 5A

MARAIS, G. R.
Incidence of Sphaerotilus natans in Laboratory Scale Activated Sludge Systems.
W90-00749 5D

MARANI, A.
Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

MARCHAND, M.
Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

MARCHUK, V. N.
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

MARCOMINI, A.
Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

MAREE, J. P.
Biological Removal of Sulphate from Industrial Effluents and Concomitant Production of Sulphur.
W90-00770 5D

MARINO, M. A.
Solute Movement Through Root-soil Environment.
W90-00885 2I

MARTEL, C. J.
Development and Design of Sludge Freezing Beds.
W90-00661 5E

MARTIN, P.
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

MARTIN, R.
Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

MARTIN VIDE, J. P.
Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

MARTINEZ, A.
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

MARTINEZ, P. L.
Proposed Biological Management of Mysis relicta in Colorado Lakes and Reservoirs.
W90-00614 8I

MARTINO, L. E.
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

MARTINSON, D.
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

MARTY, D.
Mineralization of Organic Material in Coastal Eutrophic Ecosystems According to Available Terminal Electron Acceptors.
W90-00288 2L

MARUYAMA, T.
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

MARWAHA, S. S.
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

MAS, F.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

MASCLE, A.
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

MASKARINEC, M. P.
Recommendations for Holding Times of Environmental Samples.
W90-00152 5A

MASLIA, M. L.
Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

MASON, C. F.
Acidification and Otter (Lutra lutra) Distribution in Scotland.
W90-00816 5C

MASON, M. J.
Field Guide to the Application of Dispersants to Oil Spills.
W90-00140 5G

MASSCHELEIN, W. J.
Removal of the Typical Isotopes of the Chernobyl Fall-Out by Conventional Water Treatment.
W90-00824 5F

MATHAVAN, G. N.
Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

MATHER, J. D.
Groundwater Pollution and the Disposal of Hazardous and Radioactive Wastes.
W90-00926 5E

MATHEWS, A. E.
Conflict, Controversy, and Compromise: The Concho Water Snake (Nerodia harteri paucimaculata) versus the Stacy Dam and Reservoir.
W90-00454 6G

MATSUMOTO, J.
Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

MATSUMOTO, M. R.
Improvements in Soil Absorption Trench Design.
W90-00665 5D

MATSUO, T.
Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA

Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

MATTHIJS, E.
Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

MATULICH, S. C.
Designing Cost-Effective Habitat Management Plans using Optimization Methods.
W90-00123 6A

MAUGERI, T. L.
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

MAURINO, V.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

MAVINIC, D. S.
Anoxic-Aerobic Digestion of Waste Activated Sludge: I. Solids Reduction and Digested Sludge Characteristics.
W90-00493 5D

Anoxic-Aerobic Digestion of Waste Activated Sludge: II. Supernatant Characteristics, ORP Monitoring Results and Overall Rating System.
W90-00494 5D

MAXWELL, M. J.
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

MAYFIELD, C. I.
Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

MAZURSKI, K. R.
Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

MBAGWU, J. S. C.
Influence of Cattle-Feedlot Manure on Aggregate Stability, Plastic Limit and Water Relations of Three Soils in North-Central Italy.
W90-00531 5E

MCANALLY, W. H.
Cohesive Sediment Transport: II. Application.
W90-00631 2L

MCBEAN, E. A.
Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

MCBRIDE, A.
Contamination of Fish by 2,3,7,8-Tetrachlorodibenzo-P-Dioxin: A Survey of Fish from Major Watersheds in the Untied States.
W90-00481 5C

MCCOLL, J. G.
Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

MCCONNELL, S. G.
Potential Wind and Water Erodibility of Four Land-use Systems in South-Eastern Montana, U.S.A.
W90-00434 2J

MCCORMICK, J. H.
Chronic Effects of Low pH and Elevated Aluminum on Survival, Maturation, Spawning and Embryo-Larval Development of the Fathead Minnow in Soft Water.
W90-00813 5C

MCCOY, E. L.
Wettable Porous Plastic for Use as a Porous Barrier in Soil Hydraulic Studies.
W90-00389 2G

MCCURDY, R. F.
Determination of Ammonia in Water by Centrifugal Analysis.
W90-00836 5A

MCDONALD, N. S.
Decision Making Using a Drought Severity Index.
W90-00110 6A

MCDOWELL, L. L.
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

MCENTIRE, J.
Water Farms and Transfer Conflicts in Arizona, USA: A Proposed Resolution Process.
W90-00453 6E

MCFARLANE, P. N.
Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

MCINTOSH, M. S.
Nitrate Concentrations in Percolate and Groundwater Under Conventional and No-Till Zea mays Watersheds.
W90-00292 3F

MCKEON, G. M.
Evaluation the Effect of Climatic Variability on Management of Dryland Agricultural Systems in North-Eastern Australia.
W90-00117 3F

MCMAHON, T. A.
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

MEDINA, K. D.
Analysis of Surface-Water Data Network in Kansas for Effectiveness in Providing Regional Streamflow Information.
W90-00213 7A

MEHANNI, A. H.
Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

MEHTA, A. J.
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

MEIER, M. F.
Glaciers and Glaciology of Alaska.
W90-00077 2C

MEL'NIK, V. G.
Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

MELCER, H.
Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

MELE, D.
Kraft Lignin Behavior in Diffused Aeration of Kraft Effluents.
W90-00768 5D

MENDEZ, R.
Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

MENON, S. K.
Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

MERILAINEN, J.
Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

MERILUOTO, J. A. O.
Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

MERITT, M. L.
Subsurface Storage of Freshwater in South Florida: A Digital Model Analysis of Recoverability.
W90-00200 4B

METWALLY, M. E.
Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

MEYBECK, M.
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

MIAZGA, T. J.
Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

MIKAMI, E.
Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

MILANES, J.
Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

MILLER, J. E.
Changes in Flood Response of the Red River of the North Basin, North Dakota-Minnesota.
W90-00194 2E

Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

MILLER, M. C.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

MILLER, P.
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

MILLER, R. L.
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

MILLER, R. T.
Hydrogeology and Preliminary Regional Flow Modeling at the Bemidji, Minnesota, Research Site.
W90-00034 2F

MILLIS, N. F.
Microorganisms and the Aquatic Environment.
W90-00724 2H

MILLISCHER, R. J.
Bioaccumulation and Elimination of Tetrachlorobenzyltoluene (TCBT) by the Rat and by Fish.
W90-00484 5B

MILLS, A. L.
Bacterial Community Structure and Function along a Heavy Metal Gradient.
W90-00394 5C

Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

MILLS, G. S.
Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

MILLS, K. H.
Population Dynamics of Unexploited Lake Whitefish (Coregonus clupeaformis) in One Experimentally Fertilized Lake and Three Exploited Lakes.
W90-00611 8I

MINERO, C.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

MINO, T.
Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

MINTY, A.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

MINYI, C.
Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

MISRA, V.
Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

MITCHELL, J. K.
Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

MITCHELL, R. A.
Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

MITTAL, J. P.
Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

MIYACHI, S.
Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

MIYAJI, Y.
Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

MIYOSHI, S.
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

MONK, B.
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

MONTEITH, H.
Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

MONTES, R.
Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

MONTGOMERY, D. R.
Source Areas, Drainage Density, and Channel Initiation.
W90-00955 2E

MOODIE, A. R.
Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

MOORE, J. C.
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

MOORE, P. G.
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

MOORE, R. D.
Snow Hydrology of the Waimakariri Catchment, South Island, New Zealand.
W90-00935 2C

MOORE, T. R.
Over-Winter Chemistry of Subarctic Fens, Eastern Canada.
W90-00919 2H

Plant Production, Decomposition, and Carbon Efflux in a Subarctic Patterned Fen.
W90-00675 2H

MOOREHEAD, P. W.
Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

MORBERG, M.
Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

MORGAN, D. D. V.
Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

MORGAN, R. P.
Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

MORGAN, R. P. C.
Simple Model for Assessing Annual Soil Erosion on Hillslopes.
W90-00008 2J

MORGIA, C.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

MORIN, R. H.
Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

MORKOC, F.
River Quality Modeling: Time Domain Approach.
W90-00889 5B

MORRI, C.
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

MORRISON, G. M. P.
Bioavailable Metal Uptake Rate in Urban Stormwater Determined by Dialysis with Receiving Resins.
W90-00735 5B

MORRISON, S. W.
Percival Creek Corridor Plan.
W90-00326 6B

MORTON, B.
Pollution of the Coastal Waters of Hong Kong.
W90-00740 5B

MOSEY, F. E.
Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

MOSS, M. E.
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

MOUSTAKA-GOUNI, M.
Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

MRAVIK, S. C.
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

MUDROCH, A.
Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

MUELLER, C. S.
Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

MUELLER, E.
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

MUELLER, G.
Gassing of Biosuspensions in Bubble Column and Loop Reactors (Begasung von Blosuspensionen in Blasensaeuien und Schiaufenreaktoren).
W90-00190 5D

MUELLER, M. D.
Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

MUHAMMAD, A. M.
Studies on Faecal Streptococci in Wells Water Near Mosul City.
W90-00543 5B

MULKEY, L. A.
Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

MULLINS, C. E.
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

MULVEY, M.
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

MUNAWAR, M.
Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

MUNGER, J. W.
Cloudwater Chemistry in Sequoia National Park.
W90-00345 2B

MUNKITTRICK, K. R.
Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

MURAKAME, Y.
Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

MURAKAMI, S.
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

MURAOKA, K.
Characteristics of Settling Matter and its Role in Nutrient Cycles in a Deep Oligotrophic Lake.
W90-00718 2H

MURDOCH, C.
Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

MURPHREE, C. E.
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

MURPHY, E. M.
Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

MURRAY, A. M.
Some Basic Information for the Management of Urban Lakes near Perth, Western Australia.
W90-00130 5G

MUTH, K. M.
Food of Forage Fishes in Western Lake Erie, 1975-76.
W90-00841 2H

MUZIK, I.
Stochastic-Deterministic Nature of an Elemental Rainfall Runoff Process.
W90-00946 2E

NADER, D. C.
Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

NAGENDER REDDY, A.
Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

NAGESWARA RAO, R. C.
Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

NAKAGAWA, C.
Leakage of Mercury From Chelate Resin Columns by Chelate Detaching.
W90-00489 5D

NAKANISHI, H.
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

NAKATA, K.
Simulation of the Process of Sedimentation of Suspended Solids in the Yoshii River Estuary.
W90-00730 2J

NAKHLA, G. F.
Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

NALEWAJKO, C.
Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

NEAL, R. J.
Get Control of Your Activated Sludge Process.
W90-00667 5D

NEBEKER, A. V.
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

NELSON, M. A.
Algae and Associated Aquatic Bacteria.
W90-00172 5G

NEPSZY, S. J.
Factors Affecting Recruitment and Mortality Rates of Rainbow Smelt (Osmerus mordax) in Lake Erie, 1963-85.
W90-00852 2H

Yellow Perch (Perca flavescens) Growth and Mortality Rates in Lake St. Clair and the Three Basins of Lake Erie, 1963-86.
W90-00849 2H

NEUENSCHWANDER, G. G.
Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

NEVERS, E. S.
Nitrogen Removal Works Year-Round.
W90-00552 5D

NEWBIGGING, M.
Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

NEWMAN, M. C.
Allozyme Genotype and Time to Death of Mosquitofish, Gambusia affinis (Baird and Girard), During Acute Exposure to Inorganic Mercury.
W90-00313 5C

NG, W. J.
Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

NGUYEN, V.-T.-V.
Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

NICCOLAI, I.
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

NICHOLAS, J. R.
Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois.
W90-00226 5B

NICHOLLS, K. H.
Temporal and Spatial Variability in Sediment and Phosphorus Loads to Lake Simcoe, Ontario.
W90-00845 5B

NICHOLS, P. D.
Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

NICHOLS, W. D.
Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada.
W90-00218 2F

NICKLESS, G.
Evaluation of the Ability of Extractants to Release Heavy Metals From Alga and Mollusc Samples Using a Sequential Extraction Procedure.
W90-00498 5A

NIELSEN, D. R.
River Quality Modeling: Time Domain Approach.
W90-00889 5B

NIELSEN, L. P.
Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

NIIMI, A. J.
Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphen-

yls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

NISBET, T. R.
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

NIVA, T.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

NIXON, R.
Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

NOBEN, N. N.
Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

NOIKE, T.
Kinetic Study on the Methanogenesis Process in Anaerobic Digestion.
W90-00762 5D

NOLAN, B. T.
Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

NOMURA, T.
Anaerobic Fixed Bed Reactor with a Porous Ceramic Carrier.
W90-00753 5D

NOONAN, K. C.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

NORDIN, J. S.
Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

NORRIS, J. M.
Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

NORTON, S. A.
'Red Herring' Lakes and Streams in the Acid-Rain Literature.
W90-00556 5B

NORWOOD, W. P.
Sensitive Screening Bioassay technique for the Toxicological Assessment of Small Quantities of Contaminated Bottom or Suspended Sediments.
W90-00736 7B

NOSKO, B. S.
Mineral Composition of a Typical Chernozem with Regular Fertilization and Irrigation.
W90-00339 3F

NOURSE, S. M.
Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

NOVOTNY, V.
Review of Hydrologic and Water Quality Models Used for Simulation of Agricultural Pollution.
W90-00002 5B

NUNES VAZ, R. A.
Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

NUTT, S. G.
Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

NWEKE, A.
Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

NYHAN, J. W.
Application of an Agricultural Water Balance and Erosion Model in Environmental Science.
W90-00010 2J

O'BRIEN, G. K.
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

O'CONNELL, J.
Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

O'CONNELL, M. F.
Atlantic Salmon (Salmo salar) Smolt Production in a Newfoundland River System Characterized by Lacustrine Habitat.
W90-00407 8I

O'CONNOR, G. A.
Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

O'CONNOR, O. A.
Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

O'SULLIVAN, M. J.
Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

OBLINGER-CHILDRESS, C. J.
Water-Quality Data-Collection Activities in Colorado and Ohio: Phase I--Inventory and Evaluation of 1984 Programs and Costs.
W90-00208 7A

OCHS, W. J.
Future Irrigation Prospects and Actions in Developing Countries.
W90-00888 3F

OGAWA, T.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

OHGAKI, S.
Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

OKAMOTO, T.
Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

OKAZAKI, M.
Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

OKIEIMEN, F. E.
Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

OKSANEN, J.
Estimation of pH Optima and Tolerances of Diatoms in Lake Sediments by the Methods of Weighted Averaging, Least Squares and Maximum Likelihood, and Their Use for the Prediction of Lake Acidity.
W90-00592 2H

OLDEMAN, L. R.
Application of Agrometeorological Information in Relation to Rice-Based Cropping Patterns in Southeast Asia.
W90-00104 3F

OLIMPIO, J. C.
Estimation of Recharge Rates to the Sand and Gravel Aquifer Using Environmental Tritium, Nantucket Island, Massachusetts.
W90-00210 2F

OLIVER, B. G.
Assessment of Relative Toxicity of Chlorinated Dibenzo-P-Dioxins, Dibenzofurans, and Biphenyls in Lake Ontario Salmonids to Mammalian Systems Using Toxic Equivalent Factors (TEF).
W90-00437 5C

OLIVIERI, A. W.
Turbidity and Color.
W90-00164 5G

OLSON, T. M.
Hydroxyalkylsulfonate Formation: Its Role as a S(IV) Reservoir in Atmospheric Water Droplets.
W90-00344 5B

ONG, S. L.
Bio-oxidation Study of Methanol Synthetic Wastewater Using the SBR.
W90-00523 5D

ONITSUKA, S.
Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

ONSTAD, C. A.
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

ONYENKPA, V. U.
Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

OPPERHUIZEN, A.
Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

ORHON, D.
Concept of Soluble Residual Product Formation in the Modelling of Activated Sludge.
W90-00777 5D

ORIVE, E.
Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

OSSIANDER, F.
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

OSTENDORF, D. W.
Approximate Dynamic Lake Phosphorus Budget Models.
W90-00662 5C

OSTERKAMP, T. E.
Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

OSTERTAG, S.
Investigations on Treatment of Wastewater and Sludge, Nitrification and Reduction of Phosphates in Lime Pre-precipitation with Subsequent Aerobic Stabilization (Untersuchungen zur Abwasser-und Schlamm-hygienisierung, Nitrifikation und Phosphatverminderung bei der Kalkvorfallung mit Nachfolgender aerober Stabilisierung).
W90-00258 5D

OTTERSON, P.
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

OULDALI, S.
Uncertainty Modeling of Facultative Aerated Lagoon Systems.
W90-00905 5D

OWE, M.
Utility of Climatic Station Data in Making Hourly Potential Evapotranspiration Estimates for Remote Sensing Studies.
W90-00357 2D

OWENS, N. J. P.
Natural Variations in Nitrogen-15 Content of Riverine and Estuarine Sediments.
W90-00680 2L

PACE, J.
Comparison of Vibrio parahaemolyticus Grown in Estuarine Water and Rich Medium.
W90-00391 5B

PAGE, A. L.
Mechanism of Native Manganese Release in Salt-Treated Soils.
W90-00381 5B

PAGNOTTA, R.
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

PAI, P.
Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

PAL, N.
Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

PALANISAMI, K.
Evaluating the Performance of Tank Irrigation Systems.
W90-00400 3F

PALMER, D. T.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

PAN, M.
Characterization, Digestibility and Anaerobic Treatment of Leachates from Old and Young Landfills.
W90-00759 5G

PANABOKKE, C. R.
Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

PANT, N.
Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

PAPAPETROPOULOS, T.
Possible Health Effects of High Manganese Concentration in Drinking Water.
W90-00293 5F

PAPP, C. S. E.
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

PARKER, G.
Velocity Redistribution in Meandering Rivers.
W90-00627 2E

PARKER-JERVIS, F.
Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

PARKER, W. R.
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

PARKHURST, D. L.
Mine-Water Discharge, Metal Loading, and Chemical Reactions.
W90-00039 5B

PARRISH, C. C.
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

PASSINO, R.
Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

PATIL, S. G.
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

PATMONT, C. R.
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

PATRICK, W. H.
Field Technique for Measuring Wetland Soil Parameters.
W90-00386 2H

Nitrogen Flows in Louisiana Gulf Coast Salt Marsh: Spatial Considerations.
W90-00305 2L

PATTARD, M.
Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

PATTON, J. S.
Methanogenesis and Microbial Lipid Synthesis in Anoxic Salt Marsh Sediments.
W90-00302 2L

PAUL, E. A.
Nitrogen Transformations in Soils Previously Amended with Sewage Sludge.
W90-00382 5B

PAUL, J. H.
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

PAVONI, B.
Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

PAW, J. N.
Environmental Impact of Aquaculture and the Effects of Pollution on coastal Aquaculture Development in Southeast Asia.
W90-00744 5C

PEARSON, R. G.
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

PECK, A. J.
Consequences of Spatial Variability in Aquifer Properties and Data Limitations for Groundwater Modelling Practice.
W90-00228 2F

PELIZZETTI, E.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

PELLETIER, E.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

PELLETIER, P. M.
Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

PENNING-ROWSELL, E. C.
Flooding and the Quantification of 'Intangibles'.
W90-00925 6A

PENNOCK, D. J.
Hydrological and Sedimentological Influences on Boroll Catenas, Central Saskatchewan.
W90-00387 2J

PENNOCK, J. R.
Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

PEREZ-GARCIA, I.
Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

PERKINS, R. J.
Onsite Wastewater Disposal.
W90-00175 5D

PERNAK, K.-D.
Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

PERONI, C.
Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

PERRY, R.
Adsorption and Release of Phosphate from Sediments of a River Receiving Sewage Effluent.
W90-00829 5B

PERSOONE, G.
Simple Bioassay with Artemia Larvae to Determine the Acute Toxicity of Antifouling Paints.
W90-00423 5A

PESCOD, M. B.
Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

PETERS, N. E.
Specific Conductance: Theoretical Considerations and Application to Analytical Quality Control.
W90-00217 7B

PETERS, R. W.
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

PETERSEN, L. B.
Resource Utilization of Coexisting Species of Hydrophsychidae (Trichoptera).
W90-00342 2H

PETTINE, M.
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

PEVEN, C. M.
Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

PFANNKUCH, H.-O.
Mass Transfer at the Alkane Water Interface in Laboratory Columns of Porous Media.
W90-00037 5B

PFEFFER, J. T.
Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

PFLUEGER, H.
Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

PHELAN, D. J.
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

PHELPS, R. J.
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

PHELPS, S.
Slip-Lining Avoids Replacement of Break-Plagued Sewer Force Main.
W90-00794 5D

PHILBECK, R. B.
Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

PHILLIPS, D. J. H.
Aquatic Pollution in the Far East.
W90-00739 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

PHILLIPS, J. D.
Evaluation of the Factors Determining the Effectiveness of Water Quality Buffer Zones.
W90-00359 5G

PHILLIPS, S. W.
Aqueous Geochemistry of the Magothy Aquifer, Maryland.
W90-00223 2K

PIERCE, G. E.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

PIGNET, P.
Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

PIKE, E. B.
Water Recreation and Risk.
W90-00923 4C

PILUK, R. J.
Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

PINNEKAMP, J.
Effects of Thermal Pretreatment of Sewage Sludge on Anaerobic Digestion.
W90-00755 5D

PIOREWICZ, J.
Hydro-sedimentology of the Johnstone River Estuary.
W90-00700 2L

Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

PIVOVAR, N. G.
Experimental Investigations of Groin Systems of an Unconventional Layout.
W90-00791 8A

PLACET, M.
Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

PLAMONDON, A. P.
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

PLEBAN, S.
Improved Approach to Irrigation Scheduling Programs.
W90-00883 3F

PODA, G.
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

POHLMAN, A. A.
Organic Oxidation and Manganese and Aluminum Mobilization in Forest Soils.
W90-00380 2K

POINDEXTER, M. E.
Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

POLLACK, A. K.
Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

POLPRASERT, C.
Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

POMAR, L. A.
Distribution and Activity of Picophytoplankton in a Brackish Environment.
W90-00284 2H

POPE, L. M.
Relation of Urban Land-Use and Dry-Weather, Storm, and Snowmelt Flow Characteristics to Stream-Water Quality, Shunganunga Creek Basin, Topeka, Kansas.
W90-00205 4C

POPLAWSKI, W. A.
Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

POPPE, A.
Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

POREL, G.
Stochastic Approach of the Hydrodynamic Dispersion in a Fractured Medium: Variability of the Dispersion Coefficient (Approche Stochastique de L'Hydrodispersion en Milieu Fissure: Variabilite du Coefficient de Dispersion).
W90-00370 2F

POROT, V.
Organic Pollutants in Urban Sewage and Pollutant Inputs to the Marine Environment. Application to the French Shoreline (Les Pollutants Organiques dans les Effluents Urbains et Apports Pollutants dans le Milieu Marin. Cas du Littoral Francais).
W90-00906 5B

POTGIETER, D. J. J.
Isolation and Characterization of Volutin Granules as Subcellular Components Involved in Biological Phosphorus Removal.
W90-00782 5D

POWELL, T. M.
Spatial and Temporal Variability in South San Francisco Bay (USA). I. Horizontal Distributions of Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity.
W90-00784 2L

Spatial and Temporal Variability in South San Francisco Bay (USA). II. Temporal Changes in Salinity, Suspended Sediments, and Phytoplankton Biomass and Productivity Over Tidal Time Scales.
W90-00785 2L

POWLEDGE, G. R.
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

PRASAD, R.
Detection of Moisture Stress by Indicator Plots--A Simulation.
W90-00574 2I

PRATT, P. F.
Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

PREMAZZI, G.
Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

Flow Cytometry for Algal Studies.
W90-00903 7B

PREPAS, E. E.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

PRESCHER, M.
Dewatering Behaviour of Sewage Sludge with Inorganic and Macro-Molecular Means of Flocculation (Entwaesserungsverhalten eines Faulschlammes mit Anorganischen und Makromolekularen).
W90-00272 5D

PRETORIUS, W. A.
Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

PREVOST, M.
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

PRICE, A. G.
Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

PRICE, K. R.
Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

PRINCE, K. R.
Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

Quantitative Assessment of the Shallow Groundwater Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

PRINS, H. B. A.
Bicarbonate Utilization: Function and Mechanism.
W90-00603 2H

PROVINI, A.
Distribution of Nutrients, Trace Elements, PAHs and Radionuclides in Sediment Cores from Lake Varese (N. Italy).
W90-00712 5B

PUDDU, A.
Nutrient Remobilization Processes at the Tiber River Mouth (Italy).
W90-00719 5B

PUSEY, B. J.
Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

PUSSEMIER, L.
Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

PYKE, S. R.
Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

QIAOER, Y.
Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

QIN, R.
Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

QUADRI, R. D.
Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

QUINES, O. D.
Microorganisms: Indicators of Pollution in Integrated Livestock-Fish Farming Systems.
W90-00514 5A

QUINN, J. M.
Epilithon and Dissolved Oxygen Depletion in the Manawatu River, New Zealand: Simple Models and Management Implications.
W90-00414 5B

QUIROGA, J. M.
Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

RABENHORST, M. C.
Processes and Rates of Pedogenesis in Some Maryland Tidal Marsh Soils.
W90-00385 2G

RADKEVICH, R. O.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

RAFFERTY, M. R.
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

RAFTELIS, G. A.
Water and Wastewater Finance and Pricing.
W90-00176 5D

RAHA, A.
Lindane.
W90-00171 5G

RAINBOW, P. S.
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

RAJAGOPALAN, R.
Breakthrough Curves in Granular Media Filtration.
W90-00660 5D

RALSTON, D. C.
Mechanics of Overflow Erosion: II. Hydraulic and Design Considerations.
W90-00629 8B

Mechanics of Overflow Erosion on Embankments: I. Research Activities.
W90-00628 2J

RAM, S.
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

RAMANA RAO, J. V.
Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

RAMELOW, G. J.
Spatial and Temporal Variation of Heavy Metals in Sediment Cores from the Calcasieu River/Lake Complex.
W90-00808 5B

RAMOS-CORMENZANA,
Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

RANDOLPH, R. B.
Methods and Computer Program Documentation for Determining Anisotropic Transmissivity Tensor Components of Two-Dimensional Ground-Water Flow.
W90-00215 2F

RANG, M. C.
Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

RAO, N. H.
Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

RAO, P. S. C.
Flow Interruption: A Method for Investigating Sorption Nonequilibrium.
W90-00874 5B

RAO, Y. P.
Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

RAPIN, F.
Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

RAPP, J. B.
Organic Markers as Source Discriminants and Sediment Transport Indicators in South San Francisco Bay, California.
W90-00854 5B

RASHEEDUDDIN, M.
Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

RASID, H.
Coping with the Effects of High Water Levels on Property Hazards: North Shore of Lake Superior.
W90-00840 6F

RASMUSSEN, P. W.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

RATHORE, H. S.
Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

RATHORE, H. S.

Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

RAUDKIVI, A. J.
Entrainment of Sediments by the Turbulent Flow of Water.
W90-00699 2J

REDDY, K. J.
Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

REDDY, K. R.
Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

REDDY, S. L. N.
Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

REDHU, A.
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

REED, B. E.
Improvements in Soil Absorption Trench Design.
W90-00665 5D

REED, D. F.
SEA Consultants Inc, Cambridge, MA.
W90-00653 5F

REES, R. M.
Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

REILLY, T. E.
Effects of Boundary Conditions on the Steady-State Response of Three Hypothetical Ground-Water Systems--Results and Implications of Numerical Experiments.
W90-00220 2F

Quantitative Assessment of the Shallow Ground-Water Flow System Associated with Connetquot Brook, Long Island, New York.
W90-00216 2F

REILLY, T. W.
Analysis of the Shallow Groundwater Flow System Near Connetquot Brook, Long Island, New York.
W90-00364 2F

REINHART, K. H.
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

RENBERG, L.
Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

RENGASAMY, P.
Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

REVSBECH, N. P.
Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

RICE, D. L.
Geochemistry of Beryllium-7 in Chesapeake Bay.
W90-00678 2L

Temporal and Spatial Distribution of Beryllium-7 in the Sediments of Chesapeake Bay.
W90-00679 2L

RICE, R. C.
Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

RICHARD, J. G.
Baton Rouge Tackles Sewerage Improvements for Compliance.
W90-00797 5D

RICHARDSON, D. A.
Test For Characterizing Settleability of Anaerobic Sludge.
W90-00500 5D

RICHARDSON, J. L.
Geochemistry of Hydric Soil Salinity in a Recharge-Throughflow-Discharge Prairie-Pothole Wetland System.
W90-00384 2G

Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

RICKARD, W. H.
Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

RIDLEY-THOMAS, C. I.
Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

RILEY, S. J.
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

RINALDO, A.
Field Scale Simulation of Nutrient Losses.
W90-00015 5B

Runoff and Receiving Water Models for NPS Discharge into the Venice Lagoon.
W90-00017 5B

RIPPEN, G.
Tributyltin in the Environment--Sources, Fate and Determination: An Assessment of Present Status and Research Needs.
W90-00482 5B

RISEBROUGH, R. W.
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

RISTO, B. A.
Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

RITCHIE, J. T.
Irrigation Strategy Selection Based on Crop Yield, Water, and Energy Use Relationships: A Michigan Example.
W90-00960 3F

RITTMANN, B. E.
Rapid Biological Clean-up of Soils Contaminated with Lubricating Oil.
W90-00765 5G

RIVADENEYRA, M. A.
Influence of pH on Struvite Formation by Bacteria.
W90-00443 2K

RIVERA, L. E.
Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

RIVERA, M. D.
Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

RIVERA, S.
Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

ROBERTS, I.
Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

ROBILLARD, P. D.
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

ROBINSON, J. B.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

RODELLAR, J.
Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

RODHE, H.
Relation Between Anthropogenic SO2 Emissions and Concentration of Sulfate in Air and Precipitation.
W90-00343 5B

ROGASH, J. A.
Synoptic and Meso-Alpha Scale Meteorology of Wyoming Flash Floods.
W90-00237 2B

ROGERS, H. R.
Fate of Chlorobenzenes and Permethrins During Anaerobic Sewage Sludge Digestion.
W90-00470 5D

Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

ROLPH, G. D.
Evaluation of Precipitation Chemistry Siting Criteria Using Paired Stations from Northern Main and Southeastern Texas.
W90-00347 7A

ROSBJERG, D.
Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

ROSSI, G.
Apparatus for the In-Situ Determination of Physico-Chemical Parameters Across the Sediment-Water Interface.
W90-00504 7B

ROTH, W.
Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

ROUCH, R.
Chemical Characteristics of a Pyrenean Brook Underflow (Sur les Caracteristiques Chimiques

du Sous-Ecoulement d'un Ruisseau des Pyrenees).
W90-00598 2F

ROY, T.
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

ROY, W. R.
Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems.
W90-00141 5E

Limitation and Feasibility of the Land Disposal of Organic Solvent-contaminated Wastes.
W90-00450 5E

ROZZI, A.
Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

RUSHTON, K. R.
Numerical Analysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

RUSSELL, J. S.
Use of Climatic Data to Classify and Compare Environments.
W90-00106 2B

RUSSO, S. L.
Sludge Character and Role of Sulfate in a UASB System Treating a Paper Plant Effluent.
W90-00757 5D

RYBICKI, N. B.
Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

RYCROFT, D. W.
Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

RYDER, J. L.
Arsenic Species in Ground Water and Pore Waters in Stream Sediments Affected by Mine Drainage in Montana and Colorado.
W90-00044 5B

SADIQ, M.
Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

SAFLEY, L. M.
Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

SAGHI, M.
Study of Metal Pollution (Cd, Cu, Pb, Zn) Along the Atlantic Coast of Morocco Between Kenitra and Temara (Etude De la Pollution Mettallique (Cd, Cu, Pb, Zn) du Littoral Atlantique Marocain Entre Kenitra et Temara).
W90-00444 5B

SAITO, S.
Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

SAKTHIVADIVEL, R.
Numerical Anaiysis of Large Diameter Wells with a Seepage Face.
W90-00354 2F

SALEH, A. F. M.
Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

SALES, D.
Experimental Evaluation of Pollution Potential of Anionic Surfactants in the Marine Environment.
W90-00411 5B

SALOJARVI, K.
Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

SALVUCCI, M. E.
Plasticity in the Photosynthetic Carbon Metabolism of Submersed Aquatic Macrophytes.
W90-00608 2H

SAN JOSE, J. J.
Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

SAND-JENSEN, K.
Environmental Variables and their Effect on Photosynthesis of Aquatic Communities.
W90-00601 2H

SANDERS, J. G.
Analytical Chemistry for Environmental Sciences.
W90-00542 5A

SANESI, G.
Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

SANTSCHI, P. H.
Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

SANZ, I.
Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

SAPARI, N.
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

SARIKAYA, H. Z.
Urban Groundwater Rise Control: Case Study.
W90-00884 4C

SARMA, P. B. S.
Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

SARMA, V. A. K.
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

SARMANI, S. B.
Determination of Heavy Metals in Water, Suspended Materials and Sediments from Langat River, Malaysia.
W90-00714 5B

SARNAT, H. B.
Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

SAUER, C. G.
Geohydrology and Model Analysis of Stream-Aquifer System Along the Arkansas River in Kearny and Finney Counties, Southwestern Kansas.
W90-00196 2F

SAUNDERS, J. F.
Concentration and Transport of Dissolved and Suspended Substances in the Orinoco River.
W90-00303 2J

SAVENIJE, H. H. G.
Salt Intrusion Model for High-Water Slack, Low-Water Slack, and Mean Tide on Spread Sheet.
W90-00351 7C

SAVENKOVA, T. P.
Observations on the Downstream Movement of Juvenile Fishes in the Atrek River.
W90-00376 2E

SAYENKO, G. N.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

SCHALLA, R.
Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

SCHECHER, W. D.
Role of Organic Acids in the Acidification of Surface Waters in the Eastern U.S.
W90-00641 2K

SCHIAVON, M.
Carbofuran Transfer and Persistence in Drained Agricultural Soils Related to their Structure and Adsorption Properties.
W90-00686 5B

SCHINDLER, H.
Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
W90-00191 4A

SCHINTU, M.
Inorganic and Methyl Mercury in Inland Waters.
W90-00825 5B

SCHLUNDT, J.
Low Technology Water Purification by Bentonite Clay Flocculation as Performed in Sudanese Villages: Bacteriological Examinations.
W90-00421 5F

SCHMID, B. H.
Overland Flow Modeling: Can Rainfall Excess be Treated as Independent of Flow Depth.
W90-00350 2E

SCHMIDT, J.
Hydraulic Calculations for Flow Under Dikes on Consolidated Beds (Untergrundhydraulische Berechnungen an Flussdeichen auf Bindigen Deckschichten).
W90-00257 2F

SCHOELLHAMER, D.
Cohesive Sediment Transport: II. Application.
W90-00631 2L

SCHOFIELD, C.
Trace Element Concentrations in Fish from Three Adirondack Lakes with Different pH Values.
W90-00800 5B

SCHONBURG, M.
Radiometric Dating and Quantitative Analysis of Elements in Depth Profiles of Sediments by Means of Nuclear Physical as Well as X-ray Fluorescence and Atomic emission spectrosco-

pic Methods (Radiometrische Datierung und Quantitative Elementbestimmung in Sediment-Tiefenprofilen mit Hilfe Kernphysikallscher Sowie Roentgenfluoreszenz und atomemissions-spektrometrischer Ver-fahren).
W90-00186 5A

SCHOONEBEEK, C. A. M.
Simultaneous Determination of C1-C2 Aldehydes and Organic Acids in Aqueous Atmospheric Samples by High-Performance Liquid Chromatography.
W90-00862 5A

SCHOPEL, M.
Tailings from Coal Mining. Weathering and Solution Processes in the Tailings as Illustrated by Lysimeter Experiments (Die Abgange des Steinkohlenbergbaus. Verwitterungs und Losungsvorgange im Bergematerial, Dargestellt an Lysimeterversuchen).
W90-00180 5B

SCHOUTEN, C. J.
Ceramic Processing of Polluted Dredged Mud.
W90-00729 5E

SCHRAP, S. M.
Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

SCHREIBER, J. D.
Nutrient Flux Through a Loblolly Pine Forest Floor Using Simulated Rainfall.
W90-00388 5B

SCHRODER, M.
Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

SCHROEDER, M. P.
Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

SCHROEDER, R. A.
Microbial Populations and Nutrient Concentrations in a Jet-Fuel-Contaminated Shallow Aquifer at Tustin, California.
W90-00059 5C

SCHWAB, B. S.
Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

SCOFIELD, R.
Arsenic.
W90-00169 5G

Cyanide.
W90-00170 5G

Lindane.
W90-00171 5G

Magnesium.
W90-00167 5G

Sulfate.
W90-00168 5G

SCOPPETTONE, G. G.
Effect of Water Quality on Survival of Lahontan Cutthroat Trout Eggs in the Truckee River, West-Central Nevada and Eastern California.
W90-00222 5C

SCOTT, D. E.
Experiments on Sediment Transport in Shallow Flows in High Gradient Channels.
W90-00942 2J

SCOTT, L. K.
Respiration and Osmoregulation of the Estuarine Crab, Rhithropanopeus harrisii (Gould): Effects of the Herbicide, Alachlor.
W90-00278 5C

SCOTT, W.
What We Know/What We Did/Why/What We Will Do (about Acid Rain).
W90-00075 5G

SCUDLARK, J. R.
Sedimentary Flux of Nutrients at a Delaware Salt Marsh Site: A Geochemical Perspective.
W90-00301 2L

SCULLY, F. E.
Stable N-Chloroaldimines and Other Products of the Chlorination of Isoleucine in Model Solutions and in a Wastewater.
W90-00688 5D

SEABER, P. R.
Hydrologic Unit Maps.
W90-00207 7C

SEALOCK, L. J.
Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

SEBACHER, D. I.
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

SEITZ, J. M.
Dynamic Load Testing of Piles (Kynamische Tragfaehigkeitspruefungen bei Bohrpfaehlen).
W90-00262 8G

SEKINE, M.
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

SELLHORN, C.
Laboratory and Semi-Technical Field Experiments for Characterizing the Most Important Processes Influencing the Sorption and Mobilization of Heavy Metals in Sand-Filter-Columns (Laborexperimente und Halbtechnische Gelaendeversuche zur Charakterisierung der Wichtigsten Prozesse, Welche die Bindung und Mobilisierung von Spur Enmetallen in Langs Amsandfiltern Beeinflussen).
W90-00267 5B

SEMMENS, M. J.
Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

SETALA, H.
Leaching of N and C from Birch Leaf Litter and Raw Humus with Special Emphasis on the Influence of Soil Fauna.
W90-00961 2K

SEVCIK, K.
Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

SEVERIN, B. F.
Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

SEVERN, S. R. T.
Measurements of Sediment Toxicity of Autotrophic and Heterotrophic Picoplankton by Epifluorescence Microscopy.
W90-00738 5C

SFALANGA, M.
Some Aspects of Soil Erosion Modelling.
W90-00009 2J

SHACKELFORD, C. D.
Diffusion of Inorganic Chemical Species in Compacted Clay Soil.
W90-00875 5B

SHAFER, M. G.
Manual for Sewage Sludge Application to Croplands and Orchards.
W90-00086 5E

SHAH, N.
Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

SHAHALAM, A. B. M.
State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

SHAKYA, S. K.
Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

SHANMUGANANTHA, S.
Chemical Degradation of Substituted Aromatic Hydrocarbon Compounds in Soil/Sediment Systems.
W90-00246 5B

SHARAK GENTHNER, B. R.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

SHARP, B. B.
Dynamic Characteristics Under Low Flow Conditions in the Wakool River, N.S.W.
W90-00703 2E

SHARP, J. H.
Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

SHARPE, W. E.
Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

SHARPLEY, A. N.
Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

SHAW, R. D.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

SHAW, R. J.
Predicting Deep Drainage in the Soil From Soil Properties and Rainfall.
W90-00507 2G

SHEA, M. A.
Production, Biomass, and Trophic Interactions of Mysis relicta in Lake Ontario.
W90-00842 2H

SHEBL, D. A.
Effect of a Sewage Plant in the Distribution of Organochlorine Residues in the Diyala River, Iraq.
W90-00799 5B

SHEFFY, T. B.
Wisconsin Acid Deposition Program.
W90-00073 5G

SHEIMAN, D. A.
Save the Rain.
W90-00066 5G

SHELBY, B.
Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

SHELLY, N.
Chemical Modelling Applications to Experimental Recirculating Streams.
W90-00403 2K

SHEN, Z.
Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

SHENGLAI, Y.
Determination of Nitrite by Single-Sweep Polarography.
W90-00297 5A

SHERIDAN, J. M.
Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

SHESTAKOV, V. L.
Effect of Vibro-Compaction of Polymer-Impregnated Asphaltic Concrete Mixes on the Quality of Linings.
W90-00792 8F

SHIGAYEV, V. V.
Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

SHIN, P. K. S.
Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong.
W90-00515 5C

SHINODA, S.
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

SHORTLE, J. S.
Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

SHRIHARI, S.
Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

SHUKLA, K. N.
Verification of Kirkham's Problem of Layered Soil Drainage.
W90-00878 8D

SHUMWAY, R. H.
River Quality Modeling: Time Domain Approach.
W90-00889 5B

SHVEBS, G. I.
Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

SIEDLER, G.
Turbulent Momentum and Salt Transport in the Mixing Zone of the Elbe Estuary.
W90-00786 2L

SIEGEL, B. Z.
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

SIEGEL, D. I.
Inorganic Geochemistry of Ground Water and Aquifer Matrix: First-Year Results.
W90-00035 5C

SIEGEL, S. M.
Contribution of Mercury from Thermal Springs to the Environmental Contamination of Mt. Amiata.
W90-00647 5B

SIEGRIST, H.
Behaviour and Modelling of NTA Degradation in Activated Sludge Systems.
W90-00775 5D

SIGLEO, A. C.
Overview of Organic Compounds in Ground Water.
W90-00054 5B

SIMMONDS, L. P.
Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. IV. The Influence of Population on Water Supply and Demand.
W90-00320 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

SIMMONS, G. L.
Effects of Acidic Precipitation, O3, and Soil Mg Status on Throughfall, Soil, and Seedling Loblolly Pine Nutrient Concentrations.
W90-00648 5C

Influence of O3, Rainfall Acidity, and Soil Mg Status on Growth and Ectomycorrhizal Colonization of Loblolly Pine Roots.
W90-00807 5C

SIMONSON, G. H.
Soil Temperature and Moisture Regime Relationships within Some Rangelands of the Great Basin.
W90-00639 2G

SINCLAIR, P.
Trace Elements in Suspended Particulate Matter from the Yarra River, Australia.
W90-00715 5B

SINGH, R.
Rubber Heat Engine for Ground Water Irrigation in India.
W90-00291 3F

SINGH, R. N.
Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

SINGH, R. R.
Influence of Simultaneous Changes in Sodicity and pH on the Hydraulic Conductivity of an Alkali Soil under Rice Culture.
W90-00638 3F

SINGH, S. R.
Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

SINGHAL, R. N.
Unimpaired RNA Synthesis in Neurons and Epithelial Cells in a Freshwater Leech Exposed to the Organophosphate Insecticide Chlorpyrifos.
W90-00557 5C

SISTERSON, D. L.
Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

SITAR, N.
Stochastic Finite Element Analysis of Groundwater Flow Using the First-Order Reliability Method.
W90-00231 2F

SJOEBECK, M. L.
Toxic Effects of Metals on Fish: Evaluation of Physiological Test Methods (Toxiska Effeckter av Metaller pa Fisk: Provning av Fysiologisk Testmetdik).
W90-00271 5C

SKELLY, J. R.
Toxicity of 2-Sec-Butyl-4,6-Dinitrophenol (DINOSEB) and Monosodium Methanearsonate (MSMA), Individually and In a Mixture, to Channel Catfish (Ictalurus punctatus) and Fathead Minnows (Pimephales promealas).
W90-00314 5C

SKINNER, C.
Bureau's Data Bank--How It Works.
W90-00119 7C

SKINNER, J. V.
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

SKLADANY, G. L.
Onsite Biological Treatment of an Industrial Landfill Leachate: Microbiological and Engineering Considerations.
W90-00468 5D

SKUGGS, R. W.
Modeling Subsurface Drainage and Water Management Systems to Alleviate Potential Water Quality Problems.
W90-00016 5G

SLAVICH, F. E.
Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

SLY, P. G.
Sediment Dispersion: Part I. Fine Sediments and Significance of the Silt/Clay Ratio.
W90-00704 2J

Sediment Dispersion: Part II. Characterization by Size of Sand Fraction and Percent Mud.
W90-00705 2J

SMATH, J. A.
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

SMILES, D. E.
Predicting the Average Movement of Reactive Solutes in Soils.
W90-00506 5B

SMITH, C. N.
Development, Testing, and Applications of Nonpoint Source Models for Evaluation of Pesticides Risk to the Environment.
W90-00020 5C

SMITH, D. M.
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

SMITH, K. S.
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

SMITH, R. C. G.
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

SMITH, R. E. W.
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

SMITH, R. L.
Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

SMITH, R. M.
Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

SMITH, S. J.
Management Effects on Runoff, Soil, and Nutrient Losses from Highly Erodible Soils in the Southern Plains.
W90-00959 2J

Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

SOLER, M.
Vertical Distribution of Aliphatic and Aromatic Hydrocarbons in Mussels From the Amposta Offshore Oil Production Platform (Western Mediterranean).
W90-00473 5B

SOMPONGCHAIYAKUL, P.
Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

SONDHI, S. K.
Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

SONNTAG, W. H.
Recent Developments in Downhole Samplers for Organic and Volatile Compounds in Ground Water.
W90-00048 7B

SORENSEN, J.
Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

SOTO, M.
Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

SOUTHWORTH, G. R.
Use of Strontium-90 in Fish Vertebrae as an Effluent Exposure Tracer in PCB-Contaminated Channel Catfish.
W90-00817 5B

SOUZA, W. R.
Quality of Ground Water in Idaho.
W90-00202 2F

SOYUPAK, S.
Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

SPALDING, M. H.
Photosynthesis and Photorespiration in Freshwater Green Algae.
W90-00606 2H

SPANOS, S. K.
Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

SPENCE, D. H. N.
Photosynthesis and Photorespiration in Freshwater Organisms: Amphibious Plants.
W90-00609 2H

SPENCER, C. M.
Improved Removals of Trihalomethane Precursors by Small Water Supply Systems.
W90-00654 5F

SPEVACKOVA, V.
Trace Element Speciation in Contaminated Soils Studied by Atomic Absorption Spectrometry and Neutron Activation Analysis.
W90-00863 5A

SPRUILL, T. B.
Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas.
W90-00201 4C

SRIKANTHAN, R.
Drought Assessment Through Stochastic Analysis of Rainfall and Streamflow Data.
W90-00109 2E

SRIVASTAVA, S. K.
Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

STABEL, H.
Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

STACKHOUSE, R. A.
Interaction of Humic Acid with Selected Trace Metals: Influence on Bioaccumulation in Daphnids.
W90-00316 5C

STANLEY, D. A.
Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

STAPANIAN, M. A.
Holding Time for Samples from a Few Selected Lakes and Streams: Effects on Twenty-Five (25) Analytes.
W90-00865 5A

STAPPER, M.
Risk Analysis of Wheat Yields in Relation to Cultivar Maturity and Climatic Variability in Semi-Arid Areas, Using a Crop Growth Model.
W90-00114 3F

STAUBER, J. L.
Effect of Culture Medium on Metal Toxicity to the Marine Diatom Nitzschia closterium and the Freshwater Green Alga Chlorella pyrenoidosa.
W90-00425 5A

STEBBINS, R. G.
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

STEELE, C. W.
Effects of Sublethal Exposure to Copper on Diel Activity of Sea Catfish, Arius felis.
W90-00404 5C

STEENHUIS, T. S.
Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

STEFAN, H. G.
Formulation of Water Quality Models for Streams, Lakes, and Reservoirs: Modeler's Perspective.
W90-00145 2H

STEIN, J.
Evolution of the Snow Cover and of the Soil Hydrological and Thermal Profiles in a Basin of the Laurentidian Balsam Fir Forest (Evolution du Couvert de Neige et des Profils Hydrique et Thermique du Sol Dans un Bassin de la Sapiniere Laurentidienne).
W90-00371 2C

STEIN, P. H.
Homesteading in the Depression: A Study of Two Short-lived Homesteads in the Harquahala Valley, Arizona.
W90-00131 6G

STEINWAND, A. L.
Gypsum Occurrence in Soils on the Margin of Semipermanent Prairie Pothole Wetlands.
W90-00383 2K

STELLUTO, S.
Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

STELMAKH, L. V.
Contribution of Picoplankton to Primary Production and the Content of Chlorophyll 'a' in Eutrophic Waters as Exemplified by Sevastopol Bay.
W90-00547 2H

STEPHENSON, J. P.
Dynamic Modelling of Trace Contaminant Removal in a Municipal Sewage Treatment Plant.
W90-00778 5D

STEVENS, H. H.
Laboratory Data on Coarse-Sediment Transport for Bedload-Sampler Calibrations.
W90-00211 7B

STIEGLITZ, L.
Application of Headspace Analysis and AOX-Measurement to Leachate From Hazardous Waste Landfills.
W90-00479 5A

STOCK, W.
Environmental Behavior of Polychlorinated Mono-methyl-substituted Diphenyl-methanes (Me-PCDMs) in Comparison with Polychlorinated Biphenyls (PCBs): Part II. Environmental Residues and Aquatic Toxicity.
W90-00436 5B

STOLLENWERK, K. G.
Adsorption and Desorption of Hexavalent Chromium in an Alluvial Aquifer Near Telluride, Colorado.
W90-00060 5B

Design and Implementation of a Large-Scale Natural-Gradient Tracer Test.
W90-00029 5B

Neutralization of Acidic Ground Water in Eastern Arizona.
W90-00043 5B

STONE, M.
Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

STOREY, A. W.
Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

STOUT, B. B.
Acid Deposition: Research, Information, Policy: A Colloquium. The Role of Research in Policy Development: An Industrial Perspective.
W90-00067 5B

STOUT, B. E.
Actinide Behavior in Natural Waters.
W90-00558 5B

STRATIS, J. A.
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

STREETS, D. G.
Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Review of Acid Rain Models for Europe.
W90-00233 5B

STRIEGL, R. G.
Relations Between Quality of Urban Runoff and Quality of Lake Ellyn at Glen Ellyn, Illinois.
W90-00212 4C

STRUCEL, I.
Water Uptake by Black Spruce Seedlings from Rooting Media (Solution, Sand, Peat) Treated with Inorganic and Oxalated Aluminum.
W90-00803 5C

STRUM, R.
Distribution of Chlorinated Hydrocarbons in Sediment and Seston of the River Elbe (Chlorkohlenwasserstoff-Verteilung in Sedimenten und Schwebstofen der Elbe).
W90-00265 5B

SU, J.
Lead and Cadmium Loadings to the Great Lakes from Precipitation.
W90-00844 5B

SUAREZ, F. X.
Evaluation and Comparison of Ion Chromatography, Segmented Flow Analysis and Flow Injection Analysis for the Determination on Nitrate in Natural Surface Waters.
W90-00913 5A

SUDICKY, E. A.
Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

SUFLITA, J. M.
Anaerobic Biodegradation of Nitrogen-substituted and Sulfonated Benzene Aquifer Contaminants.
W90-00462 5B

Sequential Reductive Dehalogenation of Chloroanilines by Microorganisms from a Methanogenic Aquifer.
W90-00538 5B

SUGIYAMA, M.
Quality of the Ground Water around the Lower Reaches of the Miya River.
W90-00649 2F

SUIDAN, M. T.
Operational Control of an Anaerobic GAC Reactor Treating Hazardous Wastes.
W90-00761 5D

Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

SUMMERS, P. W.
Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

SUMMERS, R. M.
Sediment/Water-Column Flux of Nutrients and Oxygen in the Tidal Patuxent River and Estuary, Maryland.
W90-00209 2L

SUMNER, N. R.
REMISS: Research Management Information System.
W90-00129 10D

SUNDBLAD, K.
Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

SURUCU, G.
Effects of Operational Parameters on the Settling Properties of Activated Sludge.
W90-00501 5D

SUZUKI, T.
Methanogenic Degradation of Phenol and Benzoate in Acclimated Sludges.
W90-00751 5D

SVENSON, A.
Aqueous Photolysis of the Iron (III) Complexes of NTA, EDTA and DTPA.
W90-00472 5B

SVENSSON, J.
Increased Heat Abstraction from Lakes During the Winter: Methods of Accelerating Ice Formation on Lakes in Order to Increase the Amount of Energy Stored in them During the Winter (Ukad Suovarme pa Vintern: Metoder att Paskynda Islaggningen i Sjoar for Hogre Energiinnehall Vintertid).
W90-00277 2H

SVETLICHNYY, A. A.
Soil Resistance to Erosion In the Southern Ukraine and Change Therein Due to Irrigation.
W90-00338 2J

SVOBODA, I. F.
Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

SZEBENYI, I.
Wet Air Oxidation of Toxic Industrial Effluents.
W90-00772 5D

TAGUCHI, S.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

TAKAMIZAWA, K.
Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

TAKEDA, F.
Improvements in Soil Absorption Trench Design.
W90-00665 5D

TAMRAZYAN, G. P.
Global Peculiarities and Tendencies in River Discharge and Wash-Down of the Suspended Sediments: The Earth as a Whole.
W90-00358 2J

TAN, Y. K.
Comparison of Chemical Flocculation and Dissolved Air Flotation of Anaerobically Treated Palm Oil Mill Effluent.
W90-00898 5D

TANABE, S.
Aquatic Pollution in the Far East.
W90-00739 5B

Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

TANTON, T. W.
Leaching of Salts From Restructured Saline Clay Soils.
W90-00510 3F

Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

TARE, V.
Anaerobic-aerobic Treatment of Distillery Wastes.
W90-00644 5D

TARRANT, J.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

TAYLOR, K. R.
Traveltime and Dispersion in the Potomac River, Cumberland, Maryland, to Washington, D.C.
W90-00197 5B

TEASDALE, W. E.
Hydrogeologic Controls on Solute Transport in a Plume of Sewage-Contaminated Ground Water.
W90-00028 5B

TEE, K. T.
Subtidal Salinity and Velocity Variations in the St. Lawrence Estuary.
W90-00321 2L

TEETER, A. M.
Cohesive Sediment Transport: I. Process Description.
W90-00630 2J

Cohesive Sediment Transport: II. Application.
W90-00631 2L

TEFFT, J. A.
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

TELTSCH, B.
Short Term Effects of Nutrient Enrichment on the Quality of Irrigation Water.
W90-00828 5C

TEN BRINK, H. M.
Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

TESSIER, A.
Partitioning of Zinc Between the Water Column and the Oxic Sediments in Lakes.
W90-00853 5B

TESSLER, A.
Testing Readsorption of Trace Elements during Partial Chemical Extractions of Bottom Sediments.
W90-00690 5A

TETLA, R. A.
Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

TEWARI, H. K.
Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

THEMELIS, D. G.
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

THEOBAID, N.
Fate and Effects of Crude Oil, Dispersants, and Chemically Dispersed Oil in a Wadden Sea Ecosystem: Chemical Analyses (Einfluss und Auswirkungen von Rohoel, Dispergatoren und Chemisch Dispergiertem Oel auf das Oekosystem Wattenmeer: Chemische Analysesn).
W90-00261 5B

THOMAS, A. V.
Evaluation of the Streaming Current Detector--I. Use in Jar Tests.
W90-00901 5F

Evaluation of the Streaming Current Detector--II. Continuous Flow Tests.
W90-00902 5F

THOMAS, G. A.
Modelling of Nitrification at the Mogden Treatment Works.
W90-00774 5D

THOMAS, R. L.
Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

Sediment Toxicity Testing in Two Areas of Concern of the Laurentian Great Lakes: Toronto (Ontario) and Toledo (Ohio) Harbours.
W90-00727 5C

THOMAS, W. O.
Cost-effectiveness of the Stream-Gaging Program in Maine--A Prototype for Nationwide Implementation.
W90-00195 7A

THOMPSON, B. E.
Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
W90-00315 5C

THOMPSON, C.
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

THURMAN, E. M.
Fate of Ammonium in a Sewage-Contaminated Ground Water.
W90-00032 5B

Identification of Trace Organic Substances in Sewage-Contaminated Ground Water.
W90-00030 5A

TIKKANEN, P.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

TOBIN, R. K.
Standing Crop and Processing of Rainforest Litter in a Tropical Australian Stream.
W90-00593 2H

TOET, M.
DDT Residues in the Fat of Crocodiles from Lake Kariba, Zimbabwe.
W90-00674 5B

TOLLOW, A. J.
Operation of Water Supply Reservoirs by 'Control Bands' Derived by Simulation.
W90-00941 4A

TOLONEN, K.
Retention of Mercury in Sediments of the Baltic Sea Near Oulu, Finland.
W90-00561 5B

TOMLINSON, A. I.
Collection, Quality and Accessibility of Climatic and Hydrologic Data Used in Agricultural Applications in New Zealand.
W90-00120 7B

TONEY, W. L.
How to Monitor Groundwater at a Municipal Solid Waste Facility.
W90-00796 5A

TOPPING, G.
Mercury Concentrations in Fish from Contaminated Areas in Scottish Waters.
W90-00636 5C

TORRI, D.
Some Aspects of Soil Erosion Modelling.
W90-00009 2J

TOUSSAINT, D.
Possibilities of Producing Digester Gas in Municipal Sewage Treatment (Moeglichkeiten der Faulgasproduktion in Kommunalen Klaeranlagen).
W90-00275 5D

TRACY, J. C.
Solute Movement Through Root-soil Environment.
W90-00885 2I

TRANTER, M.
Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

TRESKATIS, C.
Reverse Water Level Fluctuations in Semiconfined Aquifer Systems--'Rhade Effect'.
W90-00579 2F

TRESS, J. A.
Terrestrial Ecology of Lower Colorado River Bankline Modifications.
W90-00148 6G

TREVORS, J. T.
Copper Toxicity and Chemistry in the Environment: A Review.
W90-00806 5C

TRIMBEE, A. M.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

TROTTER, B. G.
Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

TROVATELLI, L. D.
Coliform Detection from River Waters: Comparison between MPN and MF Techniques.
W90-00646 5A

TSAI, E. C.
Simple Techniques for Source Reduction of Wastes from Metal Plating Operations.
W90-00460 5D

TSANIS, I. K.
Simulation of Wind-induced Water Currents.
W90-00632 2H

TSATSARONI, E.
Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

TSEKOS, I.
Structure and Dynamics of the Phytoplankton Assemblages in Lake Volvi, Greece: II. Phytoplankton Biomass and Environmental Factors.
W90-00596 2H

TSUDA, T.
Bioconcentration and Excretion of Benthiocarb and Simetryne by Carp.
W90-00916 5B

TSUZUKI, M.
Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

TSYBAN, A. V.
Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

TUCCI, S.
Environmental Investigation of a Marine Coastal Area: Gulf of Gaeta (Tyrrhenian Sea).
W90-00709 2L

TURCOTTE, J.
Evaluation of a Gas-Phase Selective Electrode for the Quantitation of Ammonia in Liquid Piggery Wastes.
W90-00866 5A

TURNER, D. W.
In situ Bioremediation of an Underground Diesel Fuel Spill: A Case History.
W90-00456 5G

TYAGI, R.
Studies on the Removal of Some Toxic Metal Ions: II. Removal of Lead and Cadmium by Montmorillonite and Kaolinite.
W90-00490 5D

TYRASKIS, P. A.
Maximum Entropy Spectra for Regional Precipitation Analysis and Forecasting.
W90-00575 2B

TYUS, H. M.
Population Size and Status of the Razorback Sucker in the Great River Basin, Utah and Colorado.
W90-00617 8I

UDDIN, R.
Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

UKITA, M.
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

UMEBAYASHI, O.
Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

UNDAN, R. C.
Characterizing Flood-Prone Rice Areas and Predicting Flooding Hazards.
W90-00368 2E

UNDERHILL, A. H.
Simulating the Effects of Glen Canyon Dam Releases on Grand Canyon River Trips.
W90-00457 6G

UNSETH, J. D.
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

UOTILA, I.
Effects of Acid Deposition on the Catchment Area of Lake Marsjoen-Basic Study (Happaman Laskeuman Vaikutuksista Marsjon-Jarven Valuma-Alufella Pruselvitys).
W90-00276 5C

UPDEGRAFF, D. M.
Distribution of Microorganisms and Selected Metals in Mine Drainage, Stream Water, and Sediment.
W90-00040 5B

URANO, K.
Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

URQUHART, N. S.
Sources of Error in Analysis of Municipal Sludges and Sludge-Amended Soils for Di(2-ethylhexyl) Phthalate.
W90-00572 7B

USACHEV, N.
Investigations at the Kislogubsk Tidal Power Station.
W90-00788 8C

UTOOMPRURKPORN, W.
Present Status of the Aquatic Environment of Thailand.
W90-00742 5B

VALDIYA, K. S.
Diminishing Discharges of Mountain Springs in a Part of Kumaun Himalaya.
W90-00562 4C

VAN AALST, R. M.
Deposition of the Most Acidifying Components in The Netherlands During the Period 1980-1986.
W90-00348 5B

VAN BEELEN, P.
Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

VAN BERGEN, A. H. M.
Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

VAN BLADEL, R.
Relation Between the Molecular Structure and the Adsorption of Arylcarbamate, Phenylurea and Anilide Pesticides in Soil and Model Organic Adsorbents.
W90-00476 5B

VAN DER GRAAF, J. H.
Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

VAN ENGELEN, J. J. M.
Determination of Total Sulfur in Freshwater Sediments by Ion Chromatography.
W90-00418 5A

VAN HAVEREN, B. P.
Interdisciplinary Process for Protecting Instream Flows.
W90-00334 6A

VAN LOON, G. W.
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

VAN ROOY, D.
Effect of Conditioning Transport Simulations on Transmissivity, Head and Concentration Data.
W90-00229 5B

VAN VREE, H. B. R. J.
Iodine Used as a Water-Disinfectant in Turbid Waters.
W90-00821 5F

VAN WAMBEKE, F.
Heterotrophic Processes in Eutrophicated Aquatic Marine Environments.
W90-00287 5C

VANCLEUVENBERGEN, R. J. A.
Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

VANDERGUN, K. D.
Quantitative Determination of Volatile Organochlorine Compounds in Water by GC - Headspace Analysis with Dibromoethane as an Internal Standard.
W90-00438 5A

VAQUER, A.
Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

VASUDEVAN, P.
Removal of some Heavy Metals from Polluted Water by Aquatic Plants: Studies on Duckweed and Water Velvet.
W90-00528 5D

VEEN, A. W. L.
Radionuclide Levels at Two Sites in a Water Extraction Area in the Netherlands after Chernobyl.
W90-00804 5B

VEIGA, M. C.
Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

VELINSKY, D. J.
Determination of the Isotopic Composition of Ammonium-Nitrogen at the Natural Abundance Level from Estuarine Waters.
W90-00693 7B

VENDRAMIN, G. G.
Measured and Simulated Water Relations in a Douglas-Fir Forest During the Development of Drought in the Apennines, Central Italy.
W90-00958 2A

VENKATADRI, R.
Oxidation of Phenolic Poilutants by a Lignin Degrading Enzyme from the White-Rot Fungus Phanerochaete chrysosporium.
W90-00904 5D

VENTTSEL, M. V.
Scientific Basis for Ecological Standards Governing Anthropogenic Effects on the Marine Ecosystems as Exemplified by the Baltic Sea.
W90-00548 5B

VENU GOPAL, N. B. R. K.
Fluoride-Induced Changes in Carbohydrate Metabolism in the Tissues of Fresh Water Crab Barytelphusa guerini.
W90-00685 5C

VERMETTEN, A.
Import and Export of Acid Pollution in the Netherlands (Import en Export van Zuur in Nederland).
W90-00184 5B

VESELY, J.
Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

VIEIRA, J. M. P.
Development and Application of a Model for Regional Water Quality Management.
W90-00835 5G

VILLAR, E.
Chemical Composition of Rainfall in a City of Northern Spain.
W90-00812 5B

VILLENEUVE, J. P.
Evaluation of Groundwater Vulnerability to Pesticides: A Comparison Between the Pesticide DRASTIC Index and the PRZM Leaching Quantities.
W90-00877 5B

VILLEROT, M.
Study of the Sedimentological and Rheological Properties of Fluid Mud in the Fluvio-estuarine System of the Gironde Estuary.
W90-00518 2J

VIRARAGHAVAN, T.
Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

VIRTANEN, M.
Modelling the Impacts of Lake Regulation on Whitefish Stocks.
W90-00613 2H

VISSCHER, K.
Biological Degradation of Xenobiotics in Waste Management.
W90-00467 5G

VISWANATHAN, P. N.
Toxicity of Linear Alkyl Benzene Sulphonate on some Aquatic Plants.
W90-00642 5C

VITENBERG, M. V.
Soil-Cement as a Material for Constructing Dams.
W90-00789 8F

VODOPICH, D. S.
Long-term and Short-term Variation in the Physical and Chemical Limnology of a Large, Shallow, Turbid Tropical Lake (Lake Chapala, Mexico).
W90-00341 2H

VONG, R. J.
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

VOOGD, K.
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

VORON, B.
Dynamic Programming: Application to Management of an Irrigation Reservoir (Programmation Dynamique: Application a la Gestion d'une Retenue Pour l'Irrigation).
W90-00939 4A

Limitation of the Forecasting Horizon in Stochastic Dynamic Programming for Dam Operation (Limitation de l'Horizon Previsionnel de la Programmation Dynamique Stochastique en Matiere de Gestion de Barrages).
W90-00938 4A

VOZZO, S. F.
Effects of Ozone and Water Stress, Separately and in Combination, on Soybean Yield.
W90-00569 2I

VROLIJK, P.
Hydrogeochemistry in the Barbados Accretionary Complex: Leg 110 ODP.
W90-00637 2K

WABNER, D.
Development and Investigation of a Process for the Electrochemical Treatment of Wastewater (Entwicklung und Untersuchung eines Verfahrens zur Elektrochemischen Aufbereitung von Abwasser).
W90-00268 5D

WAITE, T. D.
Manganese and Iron Related Problems in Australian Water Supplies.
W90-00502 5F

WAKE, A.
Improvements in Soil Absorption Trench Design.
W90-00665 5D

WAKIMOTO, T.
Persistent Organochlorines in Japanese Coastal Waters: An Introspective Summary from a Far East Developed Nation.
W90-00745 5B

WALD, J. D.
Hydrogeochemistry of Uranium and Associated Elements at Abandoned Uranium Mines in Western North Dakota.
W90-00046 5B

WALKER, G. R.
Calibration of Frequency-Domain Electromagnetic Induction Meters and their Possible Use in Recharge Studies.
W90-00365 7B

WALKER, M. F.
Groundwater Table Simulation Under Different Rice Irrigation Practices.
W90-00879 3F

WALKER, W.
Identification of Tris(Chlorophenyl)Methanol in Blubber of Harbor Seals From Puget Sound.
W90-00471 5B

WALLIN, M.
Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

WALLING, D. E.
Particle Size Characteristics of Fluvial Suspended Sediment: An Overview.
W90-00706 2J

WALTER, M. F.
Effects of Animal Waste Control Practices on Nonpoint-Source Phosphorus Loading in the West Branch of the Delaware River Watershed.
W90-00331 5G

WALTON, W. C.
Analytical Groundwater Modeling: Flow and Contaminant Migration.
W90-00162 2F

Groundwater Pumping Tests: Design and Analysis.
W90-00159 2F

Numerical Groundwater Modeling: Flow and Contaminant Migration.
W90-00174 2F

WANG, Y.
Methanogenic Toxicity Reduction of 2,4-Dinitrophenol by Ozone.
W90-00459 5D

New Method of Design of Steam-Distillation Treatment of Wastewater.
W90-00837 5D

WANG, Y. T.
Performance Evaluation of Biofilm Reactors Using Graphical Techniques.
W90-00416 5D

WANGERSKY, P. J.
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

WANNER, J.
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

WARD, L. M.
Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

WARE, A. J.
Full-Scale Studies with an Anaerobic/Aerobic RBC Unit Treating Brewery Wastewater.
W90-00764 5D

WARNER, R. C.
Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

WARNER, R. F.
Potential in Fluvial Geomorphology of a New Mineral Identification technology (QEM*SEM).
W90-00737 7B

WARREN, C. J.
Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

WARREN, R. P.
Optimization of Water Supply Systems: Risk Analysis and Reliability of Supply.
W90-00924 5F

WARRICK, A. W.
Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

WASKAKUWA, J. R.
Acid Digestion for Sediments, Sludges, Soils, and Solid Wastes. A Proposed Alternative to EPA SW 846 Method 3050.
W90-00541 5A

WATERS, J.
Concentrations and Fate of Linear Alkylbenzene Sulphonate in Sludge Amended Soils.
W90-00833 5B

WATSON, D.
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

WATT, D.
Laser-Controlled Land Grading for Farmland Drainage In the Red River Valley: An Economic Evaluation.
W90-00328 4A

WATT, R. D.
Ozone Consumption Kinetics in Filtered Activated Sludge Effluents: A Modified Approach.
W90-00907 5D

WATTERS, R. J.
Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

WATTS, R. J.
Performance of In Situ Microcosms Compared to Actual Reservoir Behavior.
W90-00664 2H

WEAVER, D.
Effects of Flow and Weir Design on the Passage Behavior of American Shad and Salmonids in an Experimental Fish Ladder.
W90-00616 8I

WEBER, K.
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

WEBSTER, J. R.
Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

WELCH, A. H.
Arsenic in an Alluvial-Lacustrine Aquifer, Carson Desert, Western Nevada.
W90-00045 2K

WELCH, E. B.
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

WELCH, J. E.
Zinc Movement in Sewage-Sludge-Treated Soils as Influenced by Soil Properties, Irrigation Water Quality, and Soil Moisture Level.
W90-00640 5E

WENGER, R. B.
Special Design Features Take the Chill Out of Wastewater Treatment.
W90-00551 5D

WENJIANG, D.
Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

WENSU, W.
Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

WENTZ, C. A.
Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

WEST, S. D.
Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

WESTCOT, D. W.
Guidelines for Selenium in Irrigation Waters.
W90-00563 5G

WESTERMAN, P. W.
Anaerobic Lagoon Biogas Recovery Systems.
W90-00522 5D

WETZEL, K. L.
Techniques For Estimating Streamflow Characteristics in The Eastern And Interior Coal Provinces of the United States.
W90-00203 2E

WETZEL, R. G.
Epiphytic Microalgae on Natural Substrata in a Hardwater Lake: Seasonal Dynamics of Community Structure, Biomass and ATP Content.
W90-00340 2H

Kinetic Analysis of Protein Degradation by a Freshwater Wetland Sediment Community.
W90-00392 2H

WHITE, D.C.
Accumulation of poly-beta-hydroxybutyrate in a Methane-enriched, Halogenated Hydrocarbon-degrading Soil Column: Implications for Microbial Community Structure and Nutritional Status.
W90-00725 5B

WHITE, R. E.
Effect of Irrigation Rate on Solute Transport in Soil During Steady Water Flow.
W90-00352 3F

Prediction of Nitrate Leaching from a Structured Clay Soil Using Transfer Functions Derived from Externally Applied or Indigenous Solute Fluxes.
W90-00353 5B

WHITING, G. J.
Subtidal Advective Water Flux as a Potentially Important Nutrient Input to Southeastern U.S.A. Saltmarsh Estuaries.
W90-00681 2L

WICHE, G. J.
Analysis of Alternative Modifications for Reducing Backwater at the Interstate Highway 10 Crossing of the Pearl River Near Slidell, Louisiana.
W90-00199 8A

WIEDERHOLM, T.
Toxicity of Metal Polluted Sediments to Daphnia Magna and Tubifex tubifex.
W90-00728 5C

WIGLEY, T. B.
Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

WILCOX, D. A.
Migration and Control of Purple Loosestrife (Lythrum salicaria L.) along Highway Corriders.
W90-00458 4C

WILKINSON, F. M.
Leaching of Salts From Saline Heavy Clay Soils: Factors Affecting the Leaching Process.
W90-00509 3F

WILLIAMS, J. H.
Population, Growth and Water Use of Groundnut Maintained on Stored Water. I. Root and Shoot Growth.
W90-00317 3F

Population, Growth and Water Use of Groundnut Maintained on Stored Water. III. Dry Matter, Water Use and Light Interception.
W90-00319 3F

Population, Water Use and Growth of Groundnut Maintained on Stored Water. II. Transpiration and Evaporation from Soil.
W90-00318 3F

WILLIS, G. H.
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

WILSON, B. N.
Simple Models to Evaluate Non-Point Pollution Sources and Controls.
W90-00013 5B

WILSON, G. V.
Spatial Variability of Saturated Hydraulic Conductivity of the Subsoil of Two Forested Watersheds.
W90-00379 2G

WILSON, J. O.
Seasonal Variation of Methane Emissions from a Temperate Swamp.
W90-00306 2H

WINGER, P. V.
Evaluation of the Toxicity of Marine sediments and Dredge Spoils With the Microtox Bioassay.
W90-00486 5C

WINTER, A.
Results of the Harmful Effects of Selected Water Pollutants (Anilines, Phenols, Aliphatic Compounds) to Daphnia Magna.
W90-00910 5C

Results of the Harmful Effects of Water Pollutants to Daphnia magna in the 21 Day Reproduction Test.
W90-00911 5C

WINTER, C. T.
Role of Acetate in Denitrification and Biological Phosphate Removal in Modified Bardenpho Systems.
W90-00780 5D

WISE, C. M.
Survival, Reproduction and Bioconcentration in Invertebrates and Fish Exposed to Hexachlorobenzene.
W90-00312 5B

WISE, H. R.
New Zealand Rural Water Supply Concept and the Developing World.
W90-00931 5F

WITHERS, W. B. J.
Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

WITT, K. J.
Filtration Behaviour of Soil Filters (Filtrationsverhalten und Bemessung von Erdstoff-Filtern).
W90-00189 8D

WITTGREN, H. B.
Glyceria maxima for Wastewater Nutrient Removal and Forage Production.
W90-00521 5D

WOLFE, N L.
Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

Hydrolysis of Chlorostilbene Oxide: I. Hydrolysis in Homogeneous Systems.
W90-00309 5B

WOLFF, G. T.
Trace Inorganic Species in Precipitation and Their Potential use in Source Apportionment Studies.
W90-00818 5B

WONDERGEM, E.
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

WONG, C. K.
Effects of Cadmium on the Feeding Behavior of the Freshwater Cladoceran Moina macrocopa.
W90-00445 5C

WONG, K. C.
Tidally Generated Residual Currents in a Sea Level Canal or Tidal Strait with Constant Breadth and Depth.
W90-00322 2L

WONG, M. H.
Anaerobic Digestion of Pig Manure with Different Agro-industrial Wastes.
W90-00530 5D

Contamination of Soil and Plant by Recycling of Scrap Plastics.
W90-00513 5B

WONG, S. H.
Pilot Scale Aerobic Sequencing Batch Reactor for Pig Waste Treatment.
W90-00928 5D

WOTTON, D. L.
Mapping of Soils and Bedrock Sensitivity to Acidic Deposition in Manitoba.
W90-00074 5C

WOYTOWITCH, L. M.
Homogeneous Hydrolysis Rate Constants for Selected Chlorinated Methanes, Ethanes, Ethenes, and Propanes.
W90-00687 5B

WUN-JERN, N.
Sequencing Batch Anaerobic Reactor for Treating Piggery Wastewater.
W90-00308 5D

XIBAO, C.
Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

XIUQIN, S.
Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

XU, B.-W.
New Method of Design of Steam-Distillation Treatment of Wastewater.
W90-00837 5D

XU, Z.
Geochemical Behavior of Mercury in Sediments of Changjiang River Estuary and Hangzhou Bay, (in Chinese).
W90-00373 5B

YAMAMOTO, K.
Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

YAMAMOTO, O.
Nitrogen Transformation of Wastewater From a Sea-Based Solid Waste Disposal Site and the Influence of Benthal Mud On Its Denitrification.
W90-00491 5E

YAMANAKA, H.
Ecology of Vibrio mimicus in Aquatic Environments.
W90-00396 5B

YAN, J. Q.
Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

YAZICIGIL, H.
Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

YAZIZ, M. I.
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

YEDILER, A.
Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

YEE, J. J. S.
Quality of Ground Water in Idaho.
W90-00202 2F

YEISER, J. L.
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

YING, L.
Study on the Degradation of n-Alkanes in No. 20 Diesel Oil by Natural Strains of Microorganisms from the Bohai Sea, (in Chinese).
W90-00372 5B

YITAYEW, M.
Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

Head Loss in Manifolds or Trickle Lateral: Simplified Approach.
W90-00897 3F

YODA, M.
Granular Sludge Formation in the Anaerobic Expanded Microcarrier Bed Process.
W90-00756 5D

YOSHIMURA, K.
Quantitative Structure-Toxic Activity Relationship of Fatty Acids and the Sodium Salts to Aquatic Organisms.
W90-00442 5C

YOSHPE-PURER, Y.
Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

YOUNG, C. E.
Benefits and Costs of Agricultural Nonpoint-Source Pollution Controls: The Case of St. Albans Bay.
W90-00330 5G

YOUNG, L. B.
Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

YOUNG, L. Y.
Toxicity and Biodegradation of Phthalic Acid Esters Under Methanogenic Conditions.
W90-00310 5B

YOUNG, R. A.
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

YRJANA, T.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

ZACK, A.
Geochemical Evolution of Aqueous Sodium in the Black Creek Aquifer, Horry and Georgetown Counties, South Carolina.
W90-00224 2K

ZACK, A. L.
Well System to Recover Usable Water from a Freshwater-Saltwater Aquifer in Puerto Rico.
W90-00225 4B

ZAGER, J. P.
Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

ZAIDI, B. R.
Predation and Inhibitors in Lake Water Affect the Success of Inoculation to Enhance Biodegradation of Organic Chemicals.
W90-00539 5B

ZANDER, A. K.
Membrane/Oil Stripping of VOCs From Water in Hollow-Fiber Contactor.
W90-00659 5D

ZATKAS, D. G.
Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

ZEBARTH, B. J.
Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: 1. Distribution of Water and Soils.
W90-00369 2E

ZHANG, Y.
Effect of the Microbial Population Size on the Degradation of Linear Alkylbenzene Sulfonate in Lake Water.
W90-00441 5B

Electrode system for Determination of Microbial Cell Populations in Polluted Water.
W90-00397 5A

ZHIJIE, F.
Marine Pollution Legislation in China: Retrospect and Prospect.
W90-00743 5G

ZHOU, X.
Fractionation of Particulate Matter, the Trace Metals Cu, Cd, and Zn, and Lipids in Foam and Water Below Niagara Falls.
W90-00838 2K

ZILIO, P.
Flow Cytometry for Algal Studies.
W90-00903 7B

ZIMMER, A. T.
Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

ZIMMER, D. T.
Storm Drain Design: Diffusive Flood Routing for PCs.
W90-00633 8A

ZIOGOU, K.
Behaviour of Phthalic Acid Esters During Batch Anaerobic Digestion of Sludge.
W90-00832 5D

ZOLLER, W. H.
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

ZORINA, L. G.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

ORGANIZATIONAL INDEX

A. FELIX PUBLIC HEALTH LAB., TEL-AVIV (ISRAEL).
Evaluation of Media for Monitoring Fecal Streptococci in Seawater.
W90-00395 5A

AARHUS UNIV. (DENMARK). INST. OF ECOLOGY AND GENETICS.
Denitrification in a Trickling Filter Biofilm Studied by a Microsensor for Oxygen and Nitrous Oxide.
W90-00420 5D

ABERDEEN UNIV. (SCOTLAND). DEPT. OF SOIL SCIENCE.
Variation of Soil Water Regime, Oxygen Status and Rooting Pattern with Soil Type Under Sitka Spruce.
W90-00324 2I

Soil Effects on Water Chemistry in Three Adjacent Upland Streams at Glendye in Northeast Scotland.
W90-00912 5B

ABO AKADEMI, TURKU (FINLAND). DEPT. OF BIOLOGY.
Toxic Cyanobacteria and Water Quality Problems--Examples from a Eutrophic Lake on Aland, South West Finland.
W90-00908 5B

ABO AKADEMI, TURKU (FINLAND). DEPT. OF ORGANIC CHEMISTRY.
Influence of Chlorination pH and Chlorine Dose on the Formation of Mutagenic Activity and the Strong Bacterial Mutagen 3-Chloro-4-(Dichloromethyl)-5-Hydroxy-5(2H)-Furanone (MX) in Water.
W90-00478 5F

ACADEMIA SINICA, BEIJING (CHINA). INST. OF GEOGRAPHY.
Geochemical Characteristics of Heavy Metals in the Xiangjang River, China.
W90-00716 5B

ACADEMIA SINICA, GUANGZHOU (CHINA). INST. OF ENERGY CONVERSION.
Anaerobic Digestion of Cheese Whey Using Upflow Anaerobic Sludge Blanket Reactor.
W90-00526 5D

ACADEMIA SINICA, QINGDAO (CHINA). INST. OF OCEANOLOGY.
Yangtze Brackish Water Plume: Circulation and Diffusion.
W90-00622 2L

Preliminary Study of the Basic Hydrographic Features and the Current Structures Off the Changjiang River Mouth in the Dry Season.
W90-00623 2L

ACADEMY OF ECONOMICS, WROCLAW (POLAND). DEPT. OF ECONOMIC GEOGRAPHY.
Destruction of the Agricultural Environment in Lower Silesia, Poland.
W90-00525 6A

ACUREX CORP., MOUNTAIN VIEW, CA. ENVIRONMENTAL SYSTEMS DIV.
Evaluation of EPA Method 8120 for Determination of Chlorinated Hydrocarbons in Environmental Samples.
W90-00870 5A

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC.
Natural Resources and Environmental Management in Indonesia: An Overview.
W90-00250 6A

AGRARIAN RESEARCH AND TRAINING INST., COLOMBO (SRI LANKA).
Application of Climatic and Hydrological Data in Stabilizing Production Systems in the Humid and Wet-Dry Tropics of Asia.
W90-00101 3F

AGRIC. ENGRG. DIV., BANGLADESH RICE RES. INST. (BRRI), G.P.O. BOX NO. 911, DHAKA, BANGLADESH.
Gravity Irrigation Management in Bangladesh.
W90-00887 3F

AGRICULTURAL RESEARCH AND EDUCATION CENTER, FORT PIERCE, FL.
LP Operation Model for On-demand Canal Systems.
W90-00891 3F

AGRICULTURAL RESEARCH SERVICE, DURANT, OK. WATER QUALITY AND WATERSHED RESEARCH LAB.
Prediction of Soluble Phosphorus Transport in Agricultural Runoff.
W90-00567 5B

AGRICULTURAL RESEARCH SERVICE, LAFAYETTE, IN.
Erosion and Sediment Transport Processes for Agricultural Watersheds.
W90-00006 2J

AGRICULTURAL RESEARCH SERVICE, MORRIS, MN.
AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds.
W90-00337 5B

AGRICULTURAL RESEARCH SERVICE, OXFORD, MS. SEDIMENTATION LAB.
Nitrogen and Phosphorous Yields in Run-off from Silty Soils in the Mississippi Delta, U.S.A.
W90-00431 5B

AGRICULTURAL RESEARCH SERVICE, PHOENIX, AZ. WATER CONSERVATION LAB.
Effect of Water Depth in Groundwater Recharge Basins on Infiltration.
W90-00881 2G

AGRICULTURAL RESEARCH SERVICE, SHAFTER, CA. COTTON RESEARCH STATION.
Infiltration Function from Furrow Stream Advance.
W90-00894 3F

AGRICULTURAL RESEARCH SERVICE, TIFTON, GA. SOUTHEAST WATERSHED RESEARCH CENTER.
Nitrate Movement to Groundwater In the Southeastern Coastal Plain.
W90-00329 5B

AGRICULTURAL RESEARCH SERVICE, TIFTON, GA. SOUTHEAST WATERSHED RESEARCH LAB.
Selection and Application of Models for Nonpoint Source Pollution and Resource Conservation.
W90-00012 5B

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF WATER POLLUTION CONTROL.
Methodology for the Assessment of Frequency Distribution of Combined Sewer Overflow Volumes.
W90-00909 5D

AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB., BROOKS AFB, TX. HUMAN SYSTEMS DIV.
Hazardous Waste and Wastewater Characterization Survey, Columbus AFB MS.
W90-00240 5D

AIX-MARSEILLE-1 UNIV. (FRANCE). LAB. D'HYDROBIOLOGIE.
Recent Modifications of the Aquatic Vegetation in the Etang du Vaccares (Camargue, France) in Relation with the Human Disturbances (Modifications Recentes de la Vegetation Aquatique de l'Etang du Vaccares (Camargue, France) Liees aux Perturbations Anthropiques).
W90-00600 2H

AKADEMIA ROLNICZO-TECHNICZNA, OLSZTYN-KORTOW (POLAND).
Electrobiological Wastewater Treatment.
W90-00529 5D

AKADEMIYA NAUK SSSR, MOSCOW. INST. OKEANOLOGII.
Trace Elements in the Ecosystem of Petr Velikiy Gulf.
W90-00549 5B

AKADEMIYA NAUK SSSR, MOSCOW. INST. YADERNYKH ISSLEDOVANII.
High-Sensitivity Bathyphotometer and Investigations of the Light Field of Lake Baikal.
W90-00550 7B

AKADEMIYA NAUK SSSR, YAKUTSK. INST. OF BIOLOGY.
Burbot, Lota lota, of Vilyuysk Reservoir.
W90-00375 2H

ALASKA UNIV., FAIRBANKS. GEOPHYSICAL INST.
Salt Redistribution During Freezing of Saline Sand Columns at Constant Rates.
W90-00948 2G

ALASKA UNIV., FAIRBANKS. WATER RESEARCH CENTER.
Supplemental Carbon Use by Microorganisms Degrading Toxic Organic Compounds and the Concept of Specific Toxicity.
W90-00466 5D

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Cyanide Transformation in Anaerobic Phenol-Degrading Methanogenic Cultures.
W90-00752 5D

ALBERTA UNIV., EDMONTON. DEPT. OF SOIL SCIENCE.
Leachability and Partitioning of Elements in Ferromagnetic Fly Ash Particles.
W90-00555 5B

ALBERTA UNIV., EDMONTON. DEPT. OF ZOOLOGY.
Atmospheric Deposition of Phosphorus and Nitrogen in Central Alberta with Emphasis on Narrow Lake.
W90-00645 2H

ALFRED-WEGENER-INST. FUER POLARFORSCHUNG, BREMERHAVEN (GERMANY, F.R.).
Metabolism of Octachlorostyrene in the Blue Mussel (Mytilus Edulis).
W90-00440 5B

ALIGARH MUSLIM UNIV. (INDIA). DEPT. OF APPLIED CHEMISTRY.
Novel Method for the Detection and Semiquantitative Determination of Trace Levels of 2,4-D and Related Compounds.
W90-00424 5A

Capillary Spot Test for the Detection of Trace Levels of Organophosphorus Insecticides in Water, Soil and Vegetation.
W90-00858 5A

ALIGARH MUSLIM UNIV. (INDIA). ENVIRONMENTAL RESEARCH LAB.
Heavy Metals in Water, Sediments, Plants and Fish of Kali Nadi U.P. (India).
W90-00512 5B

AMSTERDAM UNIV. (NETHERLANDS). INST. FOR TAXONOMIC ZOOLOGY.
Artificial Substrates as Standard Sampling Method for Macrofauna in Ditches: A Study in the Volgermeer Polder (Kunstmatige Substraten ais Standard-Monster-Methode voor Makrofauna in Sloten: Een Onderzoek in de Volgermeerpolder).
W90-00181 5C

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF ENVIRONMENTAL AND TOXICOLOGICAL CHEMISTRY.
Quantifying the Sorption of Organic Chemicals on Sediments.
W90-00477 5B

ANALEX CORP., CLEVELAND, OH.
Statistical Rain Attenuation Prediction Model with Application to the Advanced Communication Technology Satellite Project. I--Theoretical Development and Application to Yearly Predictions for Selected Cities in the United States.
W90-00094 2B

ANDERSON-NICHOLS AND CO., INC., PALO ALTO, CA.
Integration of Runoff and Receiving Water Models for Comprehensive Watershed Simulation and Analysis of Agricultural Management Alternatives.
W90-00014 5G

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF ZOOLOGY.
Cadmium Accumulation in Fiddler Crabs Uca annulipes Latrelle and Uca triangularis (Milne Edwards).
W90-00814 5B

ANNAMALAI UNIV., ANNAMALAINAGAR (INDIA). CENTRE OF ADVANCED STUDY IN MARINE BIOLOGY.
Variation of Phytoplankton in a Tropical Estuary (Vellar Estuary, Bay of Bengal, India).
W90-00409 2H

ANNE ARUNDEL COUNTY DEPT. OF HEALTH, ANNAPOLIS, MD.
Evaluation of On-Site Waste Disposal System for Nitrogen Reduction.
W90-00656 5E

ANTWERP UNIV., WILRIJK (BELGIUM). DEPT. OF CHEMISTRY.
Ionic Alkyllead Compounds in Environmental Water and Sediments.
W90-00707 5B

APPLIED RESEARCH CORP., LANDOVER, MD.
Statistic Useful for Characterizing Probability Distributions, with Application to Rain Rate Data.
W90-00349 7C

AQUATIC HABITAT INST., RICHMOND, CA.
Aquatic Pollution in the Far East.
W90-00739 5B

Trace Metals and Organochlorines in the Coastal Waters of Hong Kong.
W90-00741 5B

ARCHAEOLOGICAL CONSULTING SERVICES LTD., TEMPE, AZ.
Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 1.
W90-00081 6G

Settlement, Subsistence, and Specialization in the Northern Periphery: The Waddell Project, Volume 2.
W90-00082 6G

ARGONNE NATIONAL LAB., IL. BIOLOGICAL, ENVIRONMENTAL, AND MEDICAL RESEARCH DIV.
Method for Evaluation of Acidic Sulfate and Nitrate in Precipitation.
W90-00643 5A

ARGONNE NATIONAL LAB., IL. ENERGY AND ENVIRONMENTAL SYSTEMS DIV.
Historical and Future Emissions of Acidic Deposition Precursors from Man-Made Sources.
W90-00151 5B

Review of Acid Rain Models for Europe.
W90-00233 5B

Application of a Hazardous Waste Management Model for Selected Industries.
W90-00241 5D

ARIZONA STATE MUSEUM, TUCSON. CULTURAL RESOURCE MANAGEMENT DIV.
Hohokam Archaeology Along Phase B of the Tucson Aqueduct Central Arizona Project. Volume 2: Excavations at Fastimes (AZ AA:12:384), A Rillito Phase Site in the Avra Valley.
W90-00143 6G

ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ENGINEERING.
Head Loss in Manifolds or Trickle Lateral: Simplified Approach.
W90-00897 3F

ARIZONA UNIV., TUCSON. DEPT. OF CIVIL ENGINEERING.
Seasonal and In-Mill Aspects of Organic Halide Removal by an Aerated Stabilization Basin Treating a Kraft Mill Wastewater.
W90-00767 5D

ARIZONA UNIV., TUCSON. DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Field Application of a Finite-Element Water-Quality Model to a Coal Seam with UCG Burns.
W90-00577 5B

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Ion Elution Through Shallow Homogeneous Snow.
W90-00952 5B

Characterization and Isotopic Composition of Organic and Inorganic Carbon in the Milk River Aquifer.
W90-00954 2F

ARIZONA UNIV., TUCSON. DEPT. OF SOIL AND WATER SCIENCE.
Calculation of Distribution and Efficiency for Nonuniform Irrigation.
W90-00890 3F

ARKANSAS UNIV. AT MONTICELLO. DEPT. OF FOREST RESOURCES.
Seedling Growth Response in a Greenhouse to Four Rates of Old and New Paper Mill Sludge.
W90-00283 5E

Characteristics of Greentree Reservoirs: A Survey of Managers.
W90-00399 6G

ARMY ENGINEER DISTRICT, LOUISVILLE, KY.
Embankment Criteria and Performance Report: W.H. Harsha Lake, Little Miami River Basin, Ohio.
W90-00252 8E

ARMY ENGINEER DISTRICT, SEATTLE, WA. SEATTLE DISTRICT.
Cutoff Wall Construction to Upgrade Mud Mountain Dam.
W90-00155 8E

ARMY ENGINEER DISTRICT, ST. LOUIS, MO.
Innovative Products and Procedures Used on Chouteau Island Levee Relocation.
W90-00154 8G

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.
Sediment-Water Interactions and Contaminants in Corps of Engineers Reservoir Projects.
W90-00098 5B

Evaluation of Proposed Dredged Material Disposal Alternatives for New York/New Jersey Harbor, Phase I.
W90-00251 5E

Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River.
W90-00619 2H

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. HYDRAULICS DIV.
Intake Structure Operation Study, Lost Creek Dam, Oregon.
W90-00099 8A

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. STRUCTURES LAB.
Thermal Stress Analysis of Lock Wall: Dashields Locks, Ohio River.
W90-00088 8F

ARRIYADH DEVELOPMENT AUTHORITY, RIYADH (SAUDI ARABIA).
Numerical Modeling of a Multi-Aquifer System in Eastern Saudi Arabia.
W90-00363 2F

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Sulfide Production During Anaerobic Lagoon Treatment of Tapioca Wastewater.
W90-00517 5D

Direct Solid-Liquid Separation Using Hollow Fiber Membrane in an Activated Sludge Aeration Tank.
W90-00750 5D

ATHENS UNIV. (GREECE). SUBFACULTY OF EARTH SCIENCES.
Geological Framework and Observed Oilseeps of Zakynthos Island: Their Possible Influence on the Pollution of the Marine Environment.
W90-00625 5C

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Acidifying Potential of Atmospheric Deposition in Canada.
W90-00810 5B

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO). CHALK RIVER NUCLEAR LABS.
Measuring Groundwater Transport Through Lake Sediments by Advection and Diffusion.
W90-00947 2F

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Matching a Field Tracer Test with Some Simple Models.
W90-00953 2F

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Decision Making Using a Drought Severity Index.
W90-00110 6A

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W90-00502 5F

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W90-00358 2J

BARODA UNIV. (INDIA). DEPT. OF PHARMACY.
Extraction, Spectrophotometric and Atomic Absorption Spectrophotometric Determination of Molybdenum with Caffeic Acid and Application in High Purity Grade Steel and Environmental Samples.
W90-00300 7B

BATTELLE COLUMBUS DIV., OH. CELLULAR AND MOLECULAR BIOLOGY SECTION.
Determination and Enhancement of Anaerobic Dehalogenation: Degradation of Chlorinated Organics in Aqueous Systems.
W90-00134 5D

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W90-00086 5E

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W90-00153 5G

Catalytic Destruction of Hazardous Organics in Aqueous Wastes: Continuous Reactor System Experiments.
W90-00461 5D

Uptake of Tritiated Groundwater by Black Locust Trees.
W90-00620 2I

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA. ATMOSPHERIC SCIENCES DEPT.
Effect of the ASARCO Smelter Shutdown on the Acidity of Rainfall in the Puget Sound Area.
W90-00093 5B

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA. SITE CHARACTERIZATION AND ASSESSMENT SECTION.
Site Characterization: Technical Approaches to RCRA Compliance.
W90-00091 5G

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W90-00437 5C

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W90-00321 2L

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W90-00708 5B

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Microbial Degradation of Crude Oil and Some Model Hydrocarbons.
W90-00038 5B

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Removal of Heavy Metal Ions From Aqueous Solutions with Melon (Citrullus vulgaris) Seed Husks.
W90-00533 5D

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BILFINGER UND BERGER BAUAKTIENGESELLSCHAFT, MANNHEIM (GERMANY, F.R.).
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W90-00262 8G

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W90-00799 5B

BIOLOGICAL RESEARCH CENTER, BAGHDAD (IRAQ). DEPT. OF ENVIRONMENTAL POLLUTION.
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W90-00532 5F

BIOLOGICAL RESEARCH CENTER, BAGHDAD (IRAQ). DEPT. OF HYDROBIOLOGY.
Isolation of Saprolegniaceae from Tigris River and Notes on their Occurrence in Winter Season.
W90-00545 2H

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Engineering Solution to the Nitrate Problem of a Borehole at Swaffham, Norfolk, U.K.
W90-00366 5G

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Use of Radionuclides in the Study of Contaminant Cycling Processes.
W90-00720 5A

Coupling of Strontium and Calcium Cycles in Lake Constance.
W90-00721 2H

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W90-00646 5A

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W90-00273 5B

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W90-00519 2L

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W90-00498 5A

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W90-00527 5D

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W90-00824 5F

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W90-00772 5D

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W90-00182 5B

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W90-00910 5C

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W90-00911 5C

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W90-00559 2L

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W90-00334 6A

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W90-00119 7C

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W90-00628 2J

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W90-00629 8B

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W90-00825 5B

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W90-00345 2B

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W90-00955 2E

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W90-00380 2K

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Magnesium.
W90-00167 5G

Sulfate.
W90-00168 5G

Arsenic.
W90-00169 5G

Cyanide.
W90-00170 5G

Lindane.
W90-00171 5G

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W90-00889 5B

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W90-00333 4C

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W90-00784 2L

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W90-00537 5F

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W90-00164 5G

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W90-00563 5G

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W90-00568 5A

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W90-00943 7A

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W90-00471 5B

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W90-00797 5D

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W90-00103 3F

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W90-00222 5C

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W90-00040 5B

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W90-00043 5B

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W90-00056 5B

Modeling Sorptive Processes in Laboratory Columns.
W90-00058 2K

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W90-00060 5B

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W90-00204 2E

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W90-00205 4C

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W90-00025 5B

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W90-00026 5B

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W90-00031 5B

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W90-00193 2E

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W90-00364 2F

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W90-00674 5B

Nutrient-Enhanced Growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a Confined, Phosphorus-Limited Marine Ecosystem.
W90-00676 2L

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W90-00281 3F

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W90-00258 5D

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W90-00530 5D

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W90-00928 5D

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W90-00740 5B

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W90-00141 5E

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W90-00697 2J

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W90-00416 5D

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W90-00165 5G

Chloride.
W90-00166 5G

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W90-00172 5G

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W90-00173 5G

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Pumping Alkaline Groundwater to Restore a Put-and-Take Trout Fishery in a Stream Acidified by Atmospheric Deposition.
W90-00618 8I

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. SCHOOL OF FOREST RESOURCES.
Sample Size Requirements for Estimation of Throughfall Chemistry Beneath a Mixed Hardwood Forest.
W90-00565 7A

PERTANIAN MALAYSIA UNIV., SERDANG. DEPT. OF CHEMISTRY.
Removal of Copper From Solution Using Moss.
W90-00496 5D

PERTANIAN MALAYSIA UNIV., SERDANG. DEPT. OF ENVIRONMENTAL SCIENCES.
Variations in Rainwater Quality from Roof Catchments.
W90-00834 5F

PERTANIAN MALAYSIA UNIV., SERDANG. FACULTY OF FOOD SCIENCE AND BIOTECHNOLOGY.
Biological Treatment of Palm Oil Mill Effluent Using Tricoderma viride.
W90-00524 5D

PLYMOUTH POLYTECHNIC (ENGLAND). DEPT. OF BIOLOGICAL SCIENCES.
Effects of Zinc/Salinity Combinations on Zinc Regulation in Gammarus duebeni from the Estuary and the Sewage Treatment Works at Looe, Cornwall.
W90-00634 5C

PLYMOUTH POLYTECHNIC (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Accumulation of Organotins in Adult and Seed Oysters from Selected Estuaries Prior to the Introduction of U.K. Regulations Governing the Use of Tributyltin-Based Antifouling Paints.
W90-00554 5B

POLITECNICO DI MILANO (ITALY). IST. DI INGEGNERIA SANITARIA.
Anaerobic Treatment of Olive Mill Effluents in Polyurethane Foam Bed Reactors.
W90-00872 5D

PONDICHERRY UNIV. (INDIA). SALIM ALI SCHOOL OF ECOLOGY.
Atomic Absorption Spectrometric Microdetermination of Tungsten (VI) in Alloys and Environmental Samples After Extractive Separation with a Hydroxamic Acid into MIBK.
W90-00856 5A

Atomic Absorption Spectrometric and Spectrophotometric Trace Analysis of Uranium in Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and 4-(2-Pyridylazo) Resorcinol.
W90-00868 5A

Synergistic Spectrophotometric and Atomic Absorption Spectrometric Analysis of Zinc in Alloys and Environmental Samples with N-p-Methoxyphenyl-2-Furylacrylohydroxamic Acid and Pyridylazo Reagents.
W90-00869 5A

PORT ELIZABETH UNIV. (SOUTH AFRICA). DEPT. OF OCEANOGRAPHY.
Predicting the Fate and Effects of Chlorinated Hydrocarbons in a Coastal Marine System--South-East Indian Ocean.
W90-00867 5B

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF WATER UTILISATION ENGINEERING.
Fungal Purification of an Industrial Effluent Containing Volatile Fatty Acids by Means of a Crossflow-Microscreen Technique.
W90-00766 5D

PROCTER AND GAMBLE CO., CINCINNATI, OH. ENVIRONMENTAL SAFETY DEPT.
Mineralization of Surfactants by Microbiota of Aquatic Plants.
W90-00398 5B

PROCTER AND GAMBLE/ETC, STROMBEEK, BEVER (BELGIUM).
Photodegradation of Ferric Ethylenediaminetetra(methylenephosphonic acid) (EDTMP) in Aqueous Solution.
W90-00417 5B

PROGRAMMED INSTRUMENTS, INC., YARDLEY, PA.
Lotus 1-2-3 Applied to Flow Estimating and I/I Control.
W90-00793 7C

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY, WENATCHEE, WA.
Proportions of Hatchery- and Naturally Produced Steelhead Smolts Migrating past Rock Island Dam, Columbia River, Washington.
W90-00615 8I

PUERTO RICO UNIV., RIO PIEDRAS. AGRICULTURAL EXPERIMENT STATION.
Effects of Three Irrigation Regimes on Growth Parameters and Yield of Drip Irrigated Sweet Corn (Zea mays cv. Suresweet) (Tres Niveles de Riego, Crecimiento y Rendimiento de Maiz Dulce (Zea mays cv. Suresweet) Regado por Goteo).
W90-00586 3F

Nutrient Uptake and Growth Characteristics of Nitrogen Fertigated Sweet Peppers under Drip Irrigation and Plastic Mulch.
W90-00587 3F

Irrigation Requirements of Sorghum in South and North Coasts of Puerto Rico (Requisitos de Riego para Sorga en las Costas Sur y Norte de Puerto Rico).
W90-00588 3F

Irrigation Requirements for Plantains in Seven Ecological Regions of Puerto Rico (Requisitos de Riega para Platano en Siete Regiones Ecologicas de Puerto Rico).
W90-00589 3F

Seasonal Consumptive Use of Water by Bell and Cubanelle Peppers in Semiarid and Humid Coastal Sites in Puerto Rico.
W90-00590 2I

PUERTO RICO UNIV., RIO PIEDRAS. MICROBIAL ECOLOGY LAB.
Autecology of Vibrio vulnificus and Vibrio parahaemolyticus in Tropical Waters.
W90-00427 5B

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA). COLL. OF AGRICULTURAL ENGINEERING.
Energy Parameters for Raising Crops Under Various Irrigation Treatments in Indian Agriculture.
W90-00429 3F

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Assessment of Groundwater Potential for Conjunctive Water Use in a Large Irrigation Project in India.
W90-00367 4B

Nonlinear Equation for Groundwater Entry into Well Screens.
W90-00580 2F

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Characterization and Treatment of Dairy Effluents by Free and Immobilized Yeast.
W90-00871 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Distributed Parameter Hydrologic and Water Quality Modeling.
W90-00018 5B

Field Data Acquisition Systems.
W90-00021 7B

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Rainfall Abstraction and Infiltration in Nonpoint Source Pollution.
W90-00004 5B

Lateral Movements of Vadose Water in Layered Soils.
W90-00005 5B

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Acid Precipitation Issue: Have We Lost Sight of Past Lessons.
W90-00076 5G

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Effects of Copper on the Ultrastructure of Scenedesmus quadricauda and Chlorella vulgaris (Effets du Cuivre sur l'Ultrastructure de Scenedesmus quadricauda et Chlorella vulgaris).
W90-00406 5C

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Determination of Hydrocarbon Sources Using n-Alkane and Polyaromatic Hydrocarbon Distribution Indexes. Case Study: Rio de La Plata Estuary, Argentina.
W90-00540 5B

QUEEN MARY COLL., LONDON (ENGLAND). SCHOOL OF BIOLOGICAL SCIENCES.
Talitrid Amphipods (Crustacea) as Biomonitors for Copper and Zinc.
W90-00783 5A

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W90-00117 3F

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W90-00507 2G

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W90-00700 2L

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Sediment Transport in an Inland River in North Queensland.
W90-00702 2J

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Problems of Organization in the Science, Politics and Management of Water.
W90-00696 6B

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Effectiveness of Mechanical Aeration in Floating Aquatic Macrophyte-Based Wastewater Treatment Systems.
W90-00571 5D

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Use of Peat in the Removal of Oil From Produced Waters.
W90-00495 5D

Anaerobic Filters for Municipal Wastewater Treatment.
W90-00626 5D

RHODE ISLAND UNIV., NARRAGANSETT. CENTER FOR ATMOSPHERIC CHEMISTRY STUDIES.
Atmospheric Deposition of Chemical Contaminants to the Great Lakes.
W90-00851 5B

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Aqueous Solubility and n-Octanol/Water Partition Coefficient Correlations.
W90-00475 5B

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W90-00467 5G

Enumeration of Anaerobic and Oligotrophic Bacteria in Subsoils and Sediments.
W90-00876 5B

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W90-00348 5B

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EPA: Ground Water Handbook.
W90-00087 5G

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W90-00490 5D

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Developments in Ecological Modelling.
W90-00003 7C

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Calcium Budgets for Catchments as Interpreted by Strontium Isotopes.
W90-00918 2K

ROYAL INST. OF TECH., STOCKHOLM (SWEDEN). INSTITUTIONEN FOER KULTURTEKNIK.
Weathering Rates and Sr87/Sr86 Ratios: An Isotopic Approach.
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Partial Duration Series Method with a Fixed Number of Peaks.
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W90-00653 5F

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W90-00609 2H

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Semi-Micro C.O.D. Determination Method For High-Salinity Wastewater.
W90-00505 5D

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W90-00759 5G

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W90-00274 5A

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Water Flow in a Hummocky Landscape in Central Saskatchewan, Canada: I. Distribution of Water and Soils.
W90-00369 2E

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W90-00313 5C

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W90-00387 2J

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Comparison of the Effects of Sediments and Standard Elutriates on Phosphorus Kinetics in Lakewater.
W90-00805 5C

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W90-00682 5C

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W90-00008 2J

SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER, EDGEWATER, MD.
Photosynthesis of Salt Marsh Species.
W90-00605 2H

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Uncertainties in Streamflow Measurements Under Winter Ice Conditions, A Case Study: The Red River at Emerson, Manitoba, Canada.
W90-00951 2E

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Problems Related to the Effects of Environmental Conditions on the Improvement of Agriculture in South-East Asia.
W90-00102 3F

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W90-00833 5B

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W90-00113 2J

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W90-00325 3F

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W90-00115 3F

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Chronic Effects of Contaminated Sediments on the Urchin Lytechinus pictus.
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W90-00388 5B

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W90-00959 2J

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W90-00232 2F

Particle Travel Times of Contaminants Incorporated into a Planning Model for Groundwater Plume Capture.
W90-00356 5B

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Concept of Predictive Probability and A Simple Test for Geostatistical Model Validation.
W90-00230 7C

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W90-00665 5D

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W90-00754 5D

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W90-00267 5B

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Operation of a Town Drainage System by Outflow Control on a Rain Reservoir (Bewirtschaftung eines Stadtischen Entwasserungssystems durch Abflubsteuerung an einem Regenruckhaltebecken).
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W90-00350 2E

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Volatile Organic Losses from a Composite Water Sampler.
W90-00900 7B

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W90-00465 5D

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W90-00648 5C

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W90-00807 5C

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Simultaneous Extraction and Atomic Absorption Spectrometric Determination of 1B Group Elements (Cu, Ag, Au) from Aqueous Thiocyanate/2,2-Dipyridyl-2-Pyridylhydrazone (DPPH) Solutions.
W90-00299 7B

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Influence of pH on Adsorption of Dye-Containing Effluents With Different Bentonites.
W90-00469 5D

THURSTON REGIONAL PLANNING COUNCIL, OLYMPIA, WA.
Percival Creek Corridor Plan.
W90-00326 6B

TOKAI REGIONAL FISHERIES RESEARCH LAB., TOKYO (JAPAN).
Eelgrass Productivity on an Intertidal Flat of Central Japan.
W90-00670 2I

TOKYO UNIV. (JAPAN). DEPT. OF URBAN ENGINEERING.
Metabolism of Carboxylic Acids Located in and Around the Glycolytic Pathway and the TCA Cycle in the Biological Phosphorus Removal Process.
W90-00779 5D

Adsorption-Desorption of Phosphorus by Lake Sediments Under Anaerobic Conditions.
W90-00822 2H

Phosphorus Exchange Kinetics and Exchangeable Phosphorus Forms in Sediments.
W90-00823 5B

TOKYO UNIV. (JAPAN). INST. OF APPLIED MICROBIOLOGY.
Function of Carbonic Anhydrase in Aquatic Photosynthesis.
W90-00604 2H

TOKYO UNIV. OF AGRICULTURE AND TECHNOLOGY (JAPAN). FACULTY OF AGRICULTURE.
Copper and Zinc Balance in Soils, Rice Plants and Aquatic Systems in an Area Along the Fuchu Precipice Line, Tokyo, Japan.
W90-00811 4C

TOLEDO UNIV., OH.
Impact of Toxic Chemicals on Local Wastewater Treatment Plant and the Environment.
W90-00448 5B

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Influence of the Overstory, Understory and Upper Soil Horizons on the Fluxes of Some Ions in a Mixed Deciduous Forest.
W90-00585 2I

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY.
Concentrations and Distribution of Fe, Zn and Cu in Tissues of the White Sucker (Catostomus Commersoni) in Relation to Elevated Levels of Metals and Low pH.
W90-00723 5C

Potential Invasion of the Great Lakes by Fish Species Associated with Climatic Warming.
W90-00848 2H

TORONTO UNIV. (ONTARIO). INST. FOR ENVIRONMENTAL STUDIES.
Application of the QWASI (Quantitative Water Air Sediment Interaction) Fugacity Model to the Dynamics of Organic and Inroganic Chemicals in Lakes.
W90-00435 5B

Modeling the Long-Term Behavior of an Organic Contaminant in a Large Lake: Application to PCBs in Lake Ontario.
W90-00846 5B

TOYAMA UNIV. (JAPAN). FACULTY OF SCIENCE.
Selective and Sensitive Spectrophotometric Determination of Copper in Water after Collection of its Bathocuproine Complex on an Organic-Solvent-Soluble Membrane Filter.
W90-00428 5A

TRENT UNIV., PETERBOROUGH (ONTARIO). TRENT AQUATIC RESEARCH CENTRE.
Relationship Between Sedimentary Diatom Assemblages and Lakewater pH in 35 Quebec Lakes, Canada.
W90-00591 2H

TRINITY COLL., DUBLIN (IRELAND).
Effect of Small Changes in Incubation Temperature on the Five Day Biochemical Oxygen Demand Test.
W90-00487 5A

BOD Incubators and Temperature Variability.
W90-00488 5A

TROPICAL PESTICIDES RESEARCH INST., ARUSHA (TANZANIA).
Metal Pollution of River Msimbazi, Tanzania.
W90-00511 5B

TURIN UNIV. (ITALY). DIPT. DI CHIMICA ANALITICA.
Photodegradation of 2-Ethoxy- and 2-Butoxyethanol in the Presence of Semiconductor Particles or Organic Conducting Polymer.
W90-00492 5D

ULM UNIV. (GERMANY, F.R.). DEPT. OF BIOLOGY III.
Seasonal Cycle of Thermocyclops crassus (Fischer, 1853) (Copepoda:Cyclopoida) in a Shallow, Eutrophic lake.
W90-00402 2H

UNIVERSIDAD DEL PAIS VASCO, BILBAO (SPAIN). LAB. DE ECOLOGIA.
Comparative Study of Water Mineralization and Nutrient Status in the Main Water Courses of Biscay (Basque Country).
W90-00826 5B

UNIVERSIDAD POLITECNICA DE CATALUNA, BARCELONA (SPAIN). DEPT. OF APPLIED MATHEMATICS.
Stable Predictive Control of Open-Channel Flow.
W90-00892 8A

UNIVERSIDAD SIMON BOLIVAR, CARACAS (VENEZUELA). DEPT. DE ESTUDIOS AMBIENTALES.
Chemical Composition and Nutrient Loading by Precipitation in the Trachypogon Savannas of the Orinoco Llanos, Venezuela.
W90-00304 2K

UNIVERSIDADE ESTADUAL PAULISTA, SAO PAULO (BRAZIL). DEPT. DE FISICA.
Behavior of Dissolved Uranium in Groundwaters of the Morro do Ferro Thorium Deposit, Brazil.
W90-00361 2F

UNIVERSITAT DE LES ILLES BALEARS, PALMA DE MALLORCA (SPAIN). DEPT. DE CHEMISTRY.
Automatic System for Simultaneous Determination of Nitrates and Nitrites in Waters.
W90-00859 5A

UNIVERSITE LIBRE DE BRUXELLES (BELGIUM). GROUPE DE MICROBIOLOGIE DES MILIEUX AQUATIQUES.
Seasonal and Inter-Annual Variations of Nitrogen Diagenesis in the Sediments of a Recently Impounded Basin.
W90-00307 2H

UNIVERSITY COLL., CAMPBELL (AUSTRALIA).
Negative Role of Turbulence in Estuarine Mass Transport.
W90-00677 2L

UNIVERSITY COLL., CAMPBELL (AUSTRALIA). DEPT. OF GEOGRAPHY AND OCEANOGRAPHY.
Use of Turbidimeters in Suspended Sediment Research.
W90-00733 7B

UNIVERSITY COLL., LONDON (ENGLAND). DEPT. OF CIVIL AND MUNICIPAL ENGINEERING.
Filtration Studied with Endoscopes.
W90-00419 5F

UNIVERSITY COLL. OF NORTH WALES, BANGOR. SCHOOL OF BIOLOGICAL SCIENCES.
Biogeochemical Survey of Rivers and Streams in the Mountains and Foot-Hills Province of Arctic Alaska.
W90-00594 2H

UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE (INDIA).
Acid Rain, Cation Dissolution, and Sulphate Retention In Three Tropical Soils.
W90-00323 5C

UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF ENVIRONMENTAL SCIENCES.
Geochemical Studies in a Remote Scottish Upland Catchment II. Streamwater Chemistry During Snow-Melt.
W90-00809 5B

UNIVERSITY OF MANCHESTER INST. OF SCIENCE AND TECHNOLOGY (ENGLAND). POLLUTION RESEARCH UNIT.
Acid Treatment of Anaerobically Digested Sludge: Effect on Heavy Metal Content and Dewaterability.
W90-00516 5D

UNIVERSITY OF NEW ENGLAND, ARMIDALE (AUSTRALIA). FACULTY OF RESOURCE MANAGEMENT.
Aspects of Hydrometeorological Data, Measurement, Analysis and Application.
W90-00122 2B

UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA). DEPT. OF CIVIL ENGINEERING.
Modeling of an Ozone-Wastewater System's Kinetics.
W90-00412 5D

UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA). RESEARCH INST.
Nickel Sorption and Speciation in a Marine Environment.
W90-00713 5B

UNIVERSITY OF PUGET SOUND, TACOMA, WA.
Snow Cover of the Upper Colorado River Basin from Satellite Passive Microwave and Visual Imagery.
W90-00917 7B

UNIVERSITY OF SOUTH FLORIDA, ST. PETERSBURG. DEPT. OF MARINE SCIENCE.
Production of Extracellular Nucleic Acids by Genetically Altered Bacteria in Aquatic-Environment Microcosms.
W90-00390 5B

UNIVERSITY OF SOUTHERN MAINE, PORTLAND. DEPT. OF CHEMISTRY.
Analysis of Malathion and Its Breakdown Products in Aquaria Containing Golden Shiners (N. Chrysoleucas).
W90-00855 5B

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
Simulation of Sediment Yield from Alpine Watersheds.
W90-00007 2J

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF MICROBIOLOGY.
Assessment of Toxic Metal Biosorption by Activated Sludge from the Treatment of Coal-Gasification Effluent of a Petrochemical Plant.
W90-00410 5D

Activated Sludge Treatment of Coal-Gasification Effluent in a Petrochemical Plant: II. Metal Accumulation by Heterotrophic Bacteria.
W90-00773 5D

UNIVERSITY OF WYOMING RESEARCH CORP., LARAMIE. WESTERN RESEARCH INST.
Groundwater Restoration Field Test at the Hoe Creek Underground Coal Gasification Site.
W90-00245 5G

UPPSALA UNIV. (SWEDEN). DEPT. OF HYDROLOGY.
Sediment Trap Assemblages-A Methodological Description.
W90-00734 7B

UPPSALA UNIV. (SWEDEN). DEPT. OF TOXICOLOGY.
Selective Accumulation of Chlorinated Paraffins (C12 and C16) in the Olfactory Organ of Rainbow Trout.
W90-00474 5B

UPPSALA UNIV. (SWEDEN). LIMNOLOGISKA INSTITUTIONEN.
Importance of Sediments in Understanding Nutrient Cyclings in Lakes.
W90-00717 2H

UPPSALA UNIV. (SWEDEN). NATURGEOGRAFISKA INST.
Resuspension, Ephemeral Mud Blankets and Nitrogen Cycling in Laholmsbukten, South East Kattegat.
W90-00701 2L

Sediment Sampling Evaluated with a New Weighting Function and Index of Reliability.
W90-00732 7B

USTREDNI USTAV GEOLOGICKY, PRAGUE (CZECHOSLOVAKIA).
Occurrence and Speciation of Beryllium in Acidified Freshwaters.
W90-00827 5B

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). INST. VOOR METEOROLOGIE EN OCEANOGRAFIE.
Import and Export of Acid Pollution in the Netherlands (import en Export van Zuur in Nederland).
W90-00184 5B

VALLADOLID UNIV. (SPAIN). DEPT. OF CHEMICAL ENGINEERING.
Anaerobic Treatment of Municipal Sewage in UASB and AFBR Reactors.
W90-00499 5D

VALTION TEKNILLINEN TUTKIMUSKESKUS, OULU (FINLAND). BUILDING LAB.
Effects of Regulation on the Ecology of the Littoral Zone and the Feeding of Whitefish, Coregonus spp., in Lakes in Northern Finland.
W90-00612 2H

VANDKVALITETSINSTITUTET, HOERSHOLM (DENMARK).
Heavy Metals in Eelgrass (Zostera marina L.) During Growth and Decomposition.
W90-00710 5B

VENICE UNIV. (ITALY). DEPT. OF ENVIRONMENTAL SCIENCE.
Chemical and Physical Characteristics of Rainfall in Venice: Influence of the Sampling Method on the Reliability of the Data.
W90-00560 5B

Determination of Linear Alkylbenzenesulphonates and Alkylphenol Polyethoxylates in Commercial Products and Marine Waters by Reversed- and Normal-Phase HPLC.
W90-00860 5A

VENICE UNIV. (ITALY). FACOLTA DI CHIMICA INDUSTRIALE.
Models of Statistical Distributions for NPSP Concentrations.
W90-00019 5B

VERSUCHSANSTALT FUER BINNENSCHIFFBAU E.V., DUISBURG (GERMANY, F.R.).
Study of a Floating Wave Deflector (Untersuchung eines Schwimmenden Wellenabweisers).
W90-00266 8A

VICTORIA DEPT. OF AGRICULTURE AND RURAL AFFAIRS, TATURA (AUSTRALIA). INST. FOR IRRIGATION AND SALINTY.
Application of the Threshold Concentration Concept to Irrigation With Saline Water.
W90-00508 3C

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Variability in the Determination of Ash Free Dry Weight for Periphyton Communities: A Call for a Standard Method.
W90-00820 2H

VIENNA UNIV. (AUSTRIA). ZOOLOGISCHES INST.
Diel and Spatial Variations in Bacterial Density in a Stratified Water Column of the Gulf of Trieste.
W90-00285 2L

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Changes in Stream Organic Matter Following Watershed Disturbance.
W90-00691 4C

VIRGINIA STATE AIR POLLUTION CONTROL BOARD, RICHMOND.
Acid Deposition Program: Scope of Work.
W90-00072 5B

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL).
Guidelines for Molybdenum in Irrigation Waters.
W90-00564 5G

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA). INST. OF WATER TECHNOLOGY AND ENVIRONMENTAL PROTECTION.
Identification of Filamentous Microorganisms from Activated Sludge: A Compromise between Wishes, Needs and Possibilities.
W90-00422 5D

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Prediction of Nuisance Periphytic Biomass: A Management Approach.
W90-00899 5C

WASHINGTON UNIV., SEATTLE. DEPT. OF GEOLOGICAL SCIENCES.
Gravel Transport, Gravel Harvesting, and the Channel-Bed Degradation in Rivers Draining the Southern Olympic Mountains, Washington, U.S.A.
W90-00449 2J

WASHINGTON UNIV., SEATTLE. WILDLIFE SCIENCE GROUP.
Heavy Metal Accumulation in Small Mammals following Sewage Sludge Application to Forests.
W90-00570 5E

WATER RESEARCH CENTRE, MEDMENHAM (ENGLAND).
Occurrence of Chlorobenzenes and Permethrins in Twelve U.K. Sewage Sludges.
W90-00426 5D

Aqueous Chlorination of Permethrin.
W90-00914 5F

Water Recreation and Risk.
W90-00923 4C

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Demonstration and Evaluation of the Captor Process for Sewage Treatment.
W90-00254 5D

Patterns of Hydrogen in Biogas from the Anaerobic Digestion of Milk-Sugars.
W90-00763 5D

Sewage Treatment by Reed Bed Systems.
W90-00929 5D

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Effects of Natural Exposure to Copper and Zinc on Egg Size and Larval Copper Tolerance in White Sucker (Catostomus commersoni).
W90-00683 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Detectability of Step Trends in the Rate of Atmospheric Sulphate Deposition.
W90-00801 5A

WATERLOO UNIV. (ONTARIO). INST. FOR GROUND WATER RESEARCH.
Isotope Studies of Precipitation and Groundwater in the Sierra de las Cruces, Mexico.
W90-00360 2B

Laplace Transform Galerkin Technique: A Time-Continuous Finite Element Theory and Application to Mass Transport in Groundwater.
W90-00949 2F

WATERLOOPKUNDIG LAB. TE DELFT (NETHERLANDS).
Developing a Mathematical Model System for the Rhine: Meuse Estuary.
W90-00136 2L

WEST OF SCOTLAND AGRICULTURAL COLL., AUCHINCRUIVE. DEPT. OF MICROBIOLOGY.
Aerobic Piggery Slurry Treatment System with Integrated Heat Recovery and High-Rate Algal Ponds.
W90-00771 5D

WEST VIRGINIA UNIV., MORGANTOWN. DIV. OF PLANT AND SOIL SCIENCES.
Uptake of Nickel and Cadmium by Vegetables Grown on Soil Amended with Different Sewage Sludges.
W90-00430 5E

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF ZOOLOGY.
Spatial Variation in Fish Communities in Two South-western Australian River Systems.
W90-00692 2H

WESTINGHOUSE HANFORD CO., RICHLAND, WA. ENVIRONMENTAL DIV.
Scale Dependence of Continuum Models for Fractured Basalts.
W90-00950 2F

WESTON (ROY F.), INC., WEST CHESTER, PA.
Installation Restoration Program. Phase II-Confirmation/Quantification, Stage 2. Volume I: Luke Air Force Base, Arizona.
W90-00234 5B

WILFRID LAURIER UNIV., WATERLOO (ONTARIO). DEPT. OF GEOGRAPHY.
Effect of Particle Size, Chemistry and Mineralogy of River Sediments on Phosphate Adsorption.
W90-00503 5B

WILLING AND PARTNERS, CANBERRA (AUSTRALIA).
Requirements For and Use of a Flood and Agro-Economic Data Base.
W90-00111 7A

WISCONSIN DEPT. OF NATURAL RESOURCES, FITCHBURG.
Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions.
W90-00520 2H

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON.
Hydraulic Conductivity of Three Landfill Clay Liners.
W90-00666 5E

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON. BUREAU OF AIR MANAGEMENT.
Wisconsin Acid Deposition Program.
W90-00073 5G

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON. WATER RESOURCES RESEARCH SECTION.
Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Chemistry Characteristics.
W90-00078 5B

WISCONSIN UNIV., MADISON. DEPT. OF BOTANY.
Photosynthetic Strategies and Productivity in Aquatic Systems.
W90-00602 2H

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Analysis of Nonequilibrium Desorption of Volatile Organics During Field Test of Aquifer Decontamination.
W90-00873 5G

WISCONSIN UNIV., MADISON. DEPT. OF URBAN AND REGIONAL PLANNING.
Land Use Impacts of Private Sewage Systems in Wisconsin.
W90-00336 4C

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Distribution of Groundwater Seepage to Large Surface-Water Bodies: The Effect of Hydraulic Heterogeneities.
W90-00583 2F

Groundwater Interaction with a Kettle-Hole Lake: Relation of Observations to Digital Simulations.
W90-00584 2F

WITTEVEEN AND BOS, DEVENTER (NETHERLANDS).
Practical Performance of Various Systems for Small-Scale Wastewater Treatment During a Two-Year Field Test.
W90-00746 5D

WYOMING WATER RESEARCH CENTER, LARAMIE.
Solubility and Release of Fluorine and Molybdenum from Oil Shale Solid Wastes.
W90-00415 5B

YAMAGUCHI UNIV. (JAPAN). DEPT. OF CIVIL ENGINEERING.
Mercury Pollution in Tokuyama Bay.
W90-00711 5B

YARMOUK UNIV., IRBID (JORDAN). DEPT. OF CIVIL ENGINEERING.
State of an Arid Irrigation Reservoir Stalked with Wastewater Effluent and Storm Induced Flows.
W90-00544 5B

YARMOUK UNIV., IRBID (JORDON). DEPT. OF CHEMISTRY.
Indirect Spectrophotometric Determination of Fluoride in Water with Zirconium-SPADNS by Flow Injection Analysis.
W90-00295 5F

YOKOHAMA NATIONAL UNIV. (JAPAN). DEPT. OF MATERIAL SCIENCE AND CHEMICAL ENGINEERING.
Parameters for Predicting Fate of Organochlorine Pesticides in the Environment: I. Octanol-Water and Air-Water Partition Coefficients.
W90-00480 5B

YORK UNIV., TORONTO (ONTARIO). DEPT. OF BIOLOGY.
Photosynthetic Carbon Assimilation and the Suppression of Photorespiration in the Cyanobacteria.
W90-00607 2H

YORKSHIRE WATER AUTHORITY (ENGLAND). SOUTHERN DIV.
Operating Experiences at Langsett Water Treatment Works.
W90-00927 5F

YOUNG (ARTHUR) AND CO., CHARLOTTE, NC.
Water and Wastewater Finance and Pricing.
W90-00176 5D

ACCESSION NUMBER INDEX

W90-00001 5B
W90-00002 5B
W90-00003 7C
W90-00004 5B
W90-00005 5B
W90-00006 2J
W90-00007 2J
W90-00008 2J
W90-00009 2J
W90-00010 2J
W90-00011 2J
W90-00012 5B
W90-00013 5B
W90-00014 5G
W90-00015 5B
W90-00016 5G
W90-00017 5B
W90-00018 5B
W90-00019 5B
W90-00020 5C
W90-00021 7B
W90-00022 5B
W90-00023 2K
W90-00024 5B
W90-00025 5B
W90-00026 5B
W90-00027 5B
W90-00028 5B
W90-00029 5B
W90-00030 5A
W90-00031 5B
W90-00032 5B
W90-00033 2F
W90-00034 2F
W90-00035 5C
W90-00036 5B
W90-00037 5B
W90-00038 5B
W90-00039 5B
W90-00040 5B
W90-00041 5A
W90-00042 2F
W90-00043 5B
W90-00044 5B
W90-00045 2K
W90-00046 5B
W90-00047 7B
W90-00048 7B
W90-00049 5A
W90-00050 5A
W90-00051 5A
W90-00052 5B
W90-00053 5B
W90-00054 5B
W90-00055 5E
W90-00056 5B
W90-00057 7B
W90-00058 2K
W90-00059 5C
W90-00060 5B
W90-00061 5C
W90-00062 5B
W90-00063 5B
W90-00064 5B
W90-00065 5G
W90-00066 5G
W90-00067 5B
W90-00068 5C
W90-00069 5B
W90-00070 5A
W90-00071 5G
W90-00072 5B
W90-00073 5G
W90-00074 5C
W90-00075 5G
W90-00076 5G
W90-00077 2C
W90-00078 5B
W90-00079 5B
W90-00080 2D
W90-00081 6G
W90-00082 6G
W90-00083 5C
W90-00084 8D
W90-00085 5G
W90-00086 5E
W90-00087 5G
W90-00088 8F
W90-00089 5C
W90-00090 5G
W90-00091 5G
W90-00092 5D
W90-00093 5B
W90-00094 2B
W90-00095 6G
W90-00096 5G
W90-00097 6D
W90-00098 5B
W90-00099 8A
W90-00100 7A
W90-00101 3F
W90-00102 3F
W90-00103 3F
W90-00104 3F
W90-00105 7C
W90-00106 2B
W90-00107 2B
W90-00108 7C
W90-00109 2E
W90-00110 6A
W90-00111 7A
W90-00112 2B
W90-00113 2J
W90-00114 3F
W90-00115 3F
W90-00116 2B
W90-00117 3F
W90-00118 3F
W90-00119 7C
W90-00120 7B
W90-00121 2D
W90-00122 2B
W90-00123 6A
W90-00124 8B
W90-00125 8D
W90-00126 2J
W90-00127 2E
W90-00128 4C
W90-00129 10D
W90-00130 5G
W90-00131 6G
W90-00132 5A
W90-00133 7C
W90-00134 5D
W90-00135 8B
W90-00136 2L
W90-00137 5F
W90-00138 5B
W90-00139 2G
W90-00140 5G
W90-00141 5E
W90-00142 5C
W90-00143 6G
W90-00144 2F
W90-00145 2H
W90-00146 9C
W90-00147 9C
W90-00148 6G
W90-00149 6G
W90-00150 6G
W90-00151 5B
W90-00152 5A
W90-00153 5G
W90-00154 8G
W90-00155 8E
W90-00156 8A
W90-00157 8A
W90-00158 8A
W90-00159 2F
W90-00160 6G
W90-00161 5G
W90-00162 2F
W90-00163 5G
W90-00164 5G
W90-00165 5G
W90-00166 5G
W90-00167 5G
W90-00168 5G
W90-00169 5G
W90-00170 5G
W90-00171 5G
W90-00172 5G
W90-00173 5G
W90-00174 2F
W90-00175 5D
W90-00176 5D
W90-00177 5F
W90-00178 5E
W90-00179 5F
W90-00180 5B
W90-00181 5C
W90-00182 5B
W90-00183 5G
W90-00184 5B
W90-00185 2L
W90-00186 5A
W90-00187 5B
W90-00188 8B
W90-00189 8D
W90-00190 5D
W90-00191 4A
W90-00192 5C
W90-00193 2E
W90-00194 2E
W90-00195 7A
W90-00196 2F
W90-00197 5B
W90-00198 2F
W90-00199 8A
W90-00200 4B
W90-00201 4C
W90-00202 2F
W90-00203 2E
W90-00204 2E
W90-00205 4C
W90-00206 2F
W90-00207 7C
W90-00208 7A
W90-00209 2L
W90-00210 2F
W90-00211 7B
W90-00212 4C
W90-00213 7A
W90-00214 2A
W90-00215 2F
W90-00216 2F
W90-00217 7B
W90-00218 2F
W90-00219 2E
W90-00220 2F
W90-00221 2E
W90-00222 5C
W90-00223 2K
W90-00224 2K
W90-00225 4B
W90-00226 5B
W90-00227 2F
W90-00228 2F
W90-00229 5B
W90-00230 7C
W90-00231 2F
W90-00232 2F
W90-00233 5B
W90-00234 5B
W90-00235 5G
W90-00236 5C
W90-00237 2B
W90-00238 5F
W90-00239 5C
W90-00240 5D
W90-00241 5D
W90-00242 5F
W90-00243 5C
W90-00244 7B
W90-00245 5G
W90-00246 5B
W90-00247 5C
W90-00248 5F
W90-00249 5G
W90-00250 6A
W90-00251 5E
W90-00252 8E
W90-00253 5C
W90-00254 5D
W90-00255 5F
W90-00256 5A
W90-00257 2F
W90-00258 5D
W90-00259 2J
W90-00260 5B
W90-00261 5B
W90-00262 8G
W90-00263 5A
W90-00264 5A
W90-00265 5B
W90-00266 8A
W90-00267 5B
W90-00268 5D
W90-00269 2F
W90-00270 5G
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* U. S. GOVERNMENT PRINTING OFFICE:1989-261-908:00006

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

1990 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

Microfiche & Paper Copy Reports

Standard Prices		*Exception Prices*	
A01	$8.00	E01	$10.00
A02	11.00	E02	12.00
A03	15.00	E03	14.00
A04–A05	17.00	E04	16.50
A06–A09	23.00	E05	18.50
A10–A13	31.00	E06	21.50
A14–A17	39.00	E07	24.00
A18–A21	45.00	E08	27.00
A22–A25	53.00	E09	29.50
A99	*	E10	32.50
		E11	35.00
"N" Codes		E12	38.50
N01	$60.00	E13	41.00
N02	59.00	E14	45.00
N03	20.00	E15	48.50
		E16	53.00
		E17	57.50
		E18	62.00
		E19	69.00
		E20	80.00
		E99	*

Computer Products

Diskettes		*Magnetic Tapes*	
D01	$50	T01	$165
D02	80	T02	220
D03	130	T03	340
D04	180	T04	450
D05	230	T05	560
D06	280	T06	670
D07	330	T07	780
D08	380	T08	890
D09	430	T09	1,000
D10	480	T10	1,110
D11	530	T11	1,220
D12	580	T12	1,330
D13	630	T13	1,440
D14	680	T14	1,550
D15	730	T15	1,660
D16	780	T16	1,770
D17	830	T17	1,880
D18	880	T18	1,990
D19	930	T19	2,100
D99	*	T99	*

* Contact NTIS for price

Prices effective January 1, 1990

024002
UNIV MICROFILM INTL -90090 001 000411
300 ZEEB RD SERIALS PROC
ANN ARBOR MI 48106

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National Technical Information Service
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